Strategic Promotion and Release Decisions in the Movie Market*

Paul Belleflamme[†]   Dimitri Paolini[‡]

March 26, 2015

Abstract

We study how movie studios can strategically increase their production and promotion budgets to secure the most profitable release dates for their movies. In a game-theoretic setting, where two studios choose their budget before simultaneously setting the release date of their movie, we prove that two equilibria are possible: releases are either simultaneous (at the demand peak) or staggered (one studio delays). In the latter equilibrium, the first-mover secures its position by investing more in production and promotion. We test this prediction on a dataset of more than 1500 American movies released in ten countries over 13 years. Our empirical analysis confirms that higher budgets allow studios to move release dates closer to demand peaks.

Keywords: Motion pictures, Non-price competition, Strategic promotion, Strategic timing

JEL-Classification: L13, L82

[†]CORE and Louvain School of Management, Université catholique de Louvain, 34 Voie du Roman Pays, B-1348 Louvain la Neuve, Belgium, Paul.Belleflamme@uclouvain.be; also affiliated with CESifo.

[‡]Universita degli Studi di Sassari, CRENoS and DEIR, 07100 Sassari, Italy, dpaolini@uniss.it; also affiliated with CORE.

1 Introduction

Since the extraordinary successes of *Jaws* in the summer of 1975 and *Star Wars* two summers later, the big Hollywood studios have increasingly chosen to release their would-be blockbusters in the United States during the summer period (starting Memorial Day weekend, at the end of May), when a bigger audience is available (because kids are out of school, adults are on vacation, and heat waves drive them all inside air-conditioned theaters). This trend culminated in the summer of 2013 with the release of 31 movies aiming at a large audience.[1] Although summer 2013 outperformed the previous summer in terms of overall box-office revenues, it is not really surprising that an important number of these 31 movies flopped.[2]

To avoid a repeat of such a congested release schedule and its resulting head-to-head competition, some studios decided to make summer 2014 start earlier: Walt Disney, 21st Century Fox and Time Warner made their potential blockbuster debut in April.[3] They may have been inspired by some previous successful releases that took place outside the summer months.[4] Yet, even though the scheduling of movie releases looked smarter in 2014, summer 2015 seems to give cause for concern again, with the planned return of some of Hollywood's well-known characters.[5] And the same goes for 2016 with speculations about a possible clash of superheroes on May 16:

> "Following the recent announcement that *Captain America 3* was not moving from the May 2016 release window despite the opening of WB's *Man of Steel* sequel (dubbed *Batman vs. Superman*), Warner Bros. president of domestic distribution, Dan Feldman, basically told Bloomberg that Marvel can move their release because they have no

---

[1]Rampell (2013) reports that each of these 31 movies played on at least 3,000 screens in the US; over the previous decade, only an average of 23.3 movies reached the same distribution scale during the corresponding period.

[2]Among them *Lone Ranger*, *Turbo*, *R.I.P.D.*, *The Internship*, *After Earth*, and *White House Down.*

[3]Respectively *Captain America: The Winter Soldier*, *Rio 2*, and *Transcendence.*

[4]For example, *The Hunger Games* in March 2012, *Gravity* in October 2013 or *The Lego Movie* in February 2014.

[5]"The slate features *Star Wars* and *Avengers* films from Disney, Sony's next James Bond feature, a new *Mad Max* movie from Warner Bros., and at least six summer releases from Comcast Corp.'s Universal Pictures, including a *Bourne* sequel and *Despicable Me* spinoff." (Sakoui and Palmeri, 2014)

plans to do so: 'It doesn't make a lot of sense for two huge superhero films to open on the same date but there is a lot of time between now and 5/6/16. However at this time, we are not considering a change of date for *Batman vs. Superman*'." (quoted in Kendrick, 2014)

These recent events demonstrate that choosing release dates is a major strategic issue for movie studios, which places them, as the latter quote suggests, in a configuration that resembles a game of chicken: all studios want to have their movies released in periods of large audience and although none of them is willing to yield, they all admit that spacing out releases is preferable.

To try to induce rivals to yield, some studios announce the release of their movies well in advance. For instance, Keyes (2014) reports that "Marvel studios has mapped out films all the way to 2028" adding, however, that "[t]he roadmap of projects doesn't necessarily mean that specific films are locked in with potential dates or a strict release order." Yet, one can doubt that studios have sufficient commitment power to make such pre-announcements credible. Studios must thus find other means to scare off the competition and keep the most profitable release dates for themselves.

In this paper, we argue that production and promotion budgets can play this role. We first develop our argument in a simple game-theoretic model, where two studios choose their budget before simultaneously setting the release date of their movie. Assuming that the size of the potential audience decreases with time and that the period of exploitation in theaters has a given length, we show that two equilibrium configurations are possible: either both studios release their movie immediately (i.e., at the peak of the audience), or one studio releases its movie at the peak while the other studio only releases its movie once the exploitation of the first movie is over. Interestingly, in the equilibrium with staggered release, the first-mover invests more in production and promotion than the second-mover (whereas in the equilibrium with simultaneous release, both studios invest the same amount). As a larger budget allows a studio to 'steal' part of the audience at the rival's expense, we see that investing heavily in production and promotion may allow a studio to credibly secure the most profitable release date for itself. Our model also allows us to identify a number of factors that make staggered release more likely (and, conversely, simultaneous release less likely). In particular, we expect studios to space out more their

3

releases if their movies are closer substitutes (e.g., because they belong to the same genre), if viewership does not decay too fast after the peak, and if investment is less costly.

In the second part of the paper, we bring the predictions of our theoretical model to the data. Using information from *Box Office MOJO*, we have compiled a dataset of more than 1500 American movies released over an eleven-year period (from January 1, 2001 to December 31, 2013) in ten countries (USA/Canada, Australia, France, Germany, Italy Japan, New Zealand, South Africa, Spain and UK). For each movie, the data includes the following information: the official release dates, total box-office revenues, production costs, the genre of the movie, whether it is a sequel (or not). To verify whether movies with bigger budgets tend to be released closer to the demand peaks, we first identify the demand peaks in each season in the various countries. Then, we define our dependent variable as the number of weeks that separates the release date of movie m from the nearest demand peak. As independent variables, we include the budget of movie m, as well as the sums of the promotion budgets of the other movies released during the same week, distinguishing between movies of the same genre as m and movies of other genres; the last two variables are meant to measure the influence of competition. Finally, we regress this model using an OLS approach, controlling for countries fixed-effects.

Our empirical analysis largely confirms the predictions of the theoretical model. In particular, we show that movies with larger budgets tend to be released closer to the seasonal peaks. We also find that an increase in the total budgets of competing movies moves the release date closer to the seasonal peak, and that this effect is larger for movies of the same genre than for movies of other genres. A number of robustness checks allow us to establish the validity of these results.

The remainder of the paper is organized as follows. In Section 2, we review the existing literature and stress the novelty of our contribution. In Section 3, we develop our theoretical model, from which we draw a number of hypotheses that we test in Section 4. We discuss our results and conclude in Section 5.

2 Related literature

The movie industry has generated a large body of research in economics and in marketing. This is not surprising given the economic importance of this industry, the set of interesting issues that it raises (because of its complex production process and its uncertain demand) and the large availability of data sources. The purpose of this section is by no means to review this literature; we refer the interested reader to the complementary surveys of Eliashberg et al. (2006), Hadida (2009) and McKenzie (2012). Our goal here is to show that, despite the large collection of academic research on the movie industry, very few papers have considered the strategic aspect of release decisions and no paper so far (to the best of our knowledge) has dealt with the issue that we study in this paper, namely the interplay between budgeting and release decisions in a competitive setting.

A busy strand of the empirical literature on movies aims at estimating the demand for movies and the determinants of box-office revenues. Among these determinants, the simultaneous release of similar movies (same genre or same targeted audience) is shown to have a negative effect (see Ainslie *et al.*, 2005, Basuroy *et al.*, 2006, and Calantone *et al.*, 2010). Recently, Guttierez-Navratil *et al.* (2012) study to what extent box-office revenues are affected by the temporal distribution of rival films. Using data on movies released in five countries (USA, UK, France, Germany and Spain), they show that the effect of contemporary rivals is always larger than that of previously released movies or future rivals.

In the minority of papers that adopt an industrial organization perspective and explicitly incorporate strategic issues, a number of papers consider release decisions as the main strategic variables. However, the focus is often on the so-called 'release window', i.e., the sequence of release dates of a given movie through different distribution channels (movie theater, on-demand, DVD, cable TV, terrestrial TV). These papers argue that decisions about the release window are mainly driven by three effects: piracy, word-of-mouth and substitution across versions.[6] The analyses of the optimal release win-

---

[6]Regarding piracy, Danaher and Waldfogel (2012) make use of the variation in international release gaps and box office performances in 17 countries, together with time breaks for the adoption of BitTorrent, to identify the effect of release gaps on box office performances. They find that the longer the lag between the US release and the local foreign release, the lower the local foreign box office receipts. As for word-of-mouth, Moul (2007)

dow are either purely empirical or, if theoretical, they adopt a monopoly framework. A notable exception is Dalton and Leung (2013), who consider another strategic determinant of the choice of release window, namely the incentive for studios to avoid releasing blockbusters at the same dates. They use a discrete choice release gap decision game model to disentangle the impacts of this strategic effect from the effects of piracy and word-of-mouth. Their results suggest that all three factors have an economically significant impact on distributors' release window decision.

Only a few papers study, as we do, studios' choice of the premiere release date in a competitive setting. The closest in spirit to our paper is Krider and Weinberg (1998). They consider the competition between two movies in a share attraction framework and conduct an equilibrium analysis of the product introduction timing game; they test their model examining the 24 major movies released during the 1990 summer season. Our analysis goes much further by endogenizing the budget decision in the theoretical model and by testing the results on a much wider dataset. Close to our empirical part is Einav (2010), who develops an empirical model to study the movie release date timing game; he finds that released dates are too clustered around big holiday weekends and that box office revenues would increase if distributors shifted some holiday released by one or two weeks. Finally, Cabral and Natividad (2013) show, both theoretically and empirically, the importance for a movie's future success of leading the box office during the opening weekend (because being number one induces a greater awareness among potential viewers); although this paper does not directly consider release decisions, it stresses another reason for which studios are likely to fight to release their movies close to demand peaks.

---

evaluates the effects of user reviews and word-of-mouth on box office revenues. He shows that word-of-mouth has a positive impact on domestic box office performance. This effect provides incentives for a distributor to lengthen the release gap. As for substitution across versions, Calzada and Valetti (2012) study a model in which a studio chooses whether and when to release a theatrical version and a video version of its movie. They show, for instance, that if consumers have the possibility to watch both versions and if the studio has to negotiate with independent distributors and exhibitors, a release window is more profitable than a simultaneous release of the theatrical and video versions.

3 A theoretical model of movie competition

In this section, we present our theoretical model, which depicts a two-stage competition between two movie studios. We first describe the setting and discuss the relevance of our assumptions. Then, proceeding by backward induction, we analyze the (short-term) choice of release dates before turning to the (long-term) choice of promotional efforts.

3.1 The setting

The theoretical model that we analyze in this section tries to capture the main features of the competition between movies, while remaining reasonably simple. Our focus is on one category of players, namely *studios*, and on two strategic decisions, namely the movie's *release date* and *budget*. We justify this choice as follows. First, regarding players, Einav (2007, p. 129) explains in his description of the motion picture industry, that the industry comprises of three main players: producers (who "are in charge of all aspects relating to the production of the movie"), distributors (who "deal with the nationwide distribution of the completed movie"), and exhibitors (who "own the theaters"). Actually, as he further explains, "[t]he industry is dominated by the major studios that have integrated production and distribution", whereas "with few exceptions, exhibitors are not vertically integrated with producers or distributors." Moreover, Einav adds (p. 130) that "[c]ontracts negotiated between distributors and exhibitors are standard. Under a typical contract, the theater pays the distributor a fixed share of the box office revenues." It appears thus that the main strategic decisions regarding the competition among movies are in the hands of the studios; hence, we do not lose to much generality by leaving exhibitors out of our framework.[7]

Second, regarding strategic decisions, Einav (2007, pp. 127) notes that "[w]ith virtually no price competition, the movie's release date is one of the main short-run vehicles by which studios compete with each other." He also adds (p. 129) that on top of setting the release date, the distribution stage also involves "deciding the initial scope and locations of the release, negotiating contracts with exhibitors, and designing the national advertising

---

[7]For an analysis of the effects of vertical integration between distributors and exhibitors on inventory turnover, release decisions, run lengths, and allocations, see Filson (2005).

campaign." As indicated above, there does not seem to be much room for negotiating contracts with exhibitors, which explains why we do not consider this decision. As for the scope and location of the release, we have chosen to abstract it away to keep the model tractable (and because we lack the necessary data to assess that dimension).

More precisely, we consider the competition between two movies produced by two different studios.[8] Studios (indexed by $i, j \in \{1, 2\}$) compete in two stages. At period 0, they choose their budget $b_i, b_j \in [0, 1]$, which comprises production and marketing expenditures.[9] Next, in period 1 on, they choose the release date of their movie in theaters, $t_i, t_j \geq 1$, where $t_i = 1$ (resp. $t_i > 1$) means that the movie is released at the start of (resp. later in) the season. This sequence of decision corresponds to what is observed in reality: as noted by Vanderhart and Wiggins (2001), the advertising campaign starts before the movie release date and culminates at the time the movie is released. Einav (2002) also notes that distributors tend to pre-announce the release date of their movies so as to scare off the competition, and that this practice is more common for movies with larger budgets. This suggests again that budget decisions are made before release decisions and with a view to influence them.[10]

The number of viewers that a particular movie attracts at a particular date depends on a number of factors: (i) the budget decisions of the studios; (ii) the number of movies on show at the same date; (iii) the degree of similarity between the two movies; and (iv) the date itself. Letting $n_i(t, b_i, b_j)$ denote the expected number of viewers for movie i at date t given the budgets (b_i, b_j), we assume:

$$n_i(t, b_i, b_j) = \begin{cases} h(1 + b_i)Nt^{-\alpha} & \text{if } i \text{ is the only movie on show,} \\ h(1 + b_i - \beta b_j)Nt^{-\alpha} & \text{if both movies are on show,} \end{cases}$$

(1)

---

[8]In Section 4.3, we discuss what happens when the two movies are produced by the same studio.

[9]Thomas (2004) categorizes the various costs related to the production and promotion of a movie as follows: *Before* (Script & development, Licensing), *During* (Producers, Director, Cast, Physical production expenses), *After* (Special effects, Music, Prints & advertising).

[10]In the model, we assume that once release dates are chosen, they cannot be modified at a later stage. In reality, as reported, e.g., by Einav (2010) and Dürr *et al.* (2014), it is not uncommon that studios reschedule the release dates of their movies. We discuss this further in Section 4.3.

with $N > 0$, $h \leq \frac{1}{2}$, $b_i, b_j \in [0, 1]$, $\alpha > 0$ and $0 \leq \beta \leq 1$.

The demand function (1) should be understood as follows. First, the potential viewership for any movie at date t is equal to $Nt^{-\alpha}$, where N is the number of viewers. That is, the audience is the largest at date $t = 1$ (i.e., just after the budgets have been spent) and then it decreases at rate $\alpha > 0$ per unit of time; this translates the idea that the interest for a movie fades away as time goes by.

Second, each movie has an ex ante a probability $h \leq \frac{1}{2}$ of being chosen by any viewer.[11] Studio i can increase this ex ante probability by spending more on production and promotion, i.e., by raising b_i.[12] The ex post probability is indeed given by $h(1 + b_i)$ when movie i is the only one one show. However, if studio j releases its movie in the same period, the ex post probability that viewers will chose to watch movie i is given by $h(1 + b_i - \beta b_j)$.[13] That is, by raising its budget (b_j), studio j makes it *less* likely that movie i will be chosen.[14] The influence of the other studio's budget depends on the degree of similarity (or substitutability) between the two movies, which is parametrized by $\beta \in [0, 1]$. At one extreme, $\beta = 0$ means that the movies are totally differentiated, so that the viewership for movie i is not affected by the budget of movie j. At the other extreme, $\beta = 1$ means that the movies are perfect substitute, so that if both studios choose the same budget, they exactly neutralize each other. An example for the former case could be one teen comedy and one documentary on astrology, while an example of the latter case could be two action movies telling similar stories, and having equally popular casts.[15]

---

[11]In a more general setting with multiple movies, we can see h as a decreasing function of the number of movies released at a given date in a given location.

[12]The movie can be made more attractive to viewers not only through larger advertising expenditures (promotion costs), but also by signing more famous (and thus more expensive) cast or director, or by spending more on special effects (production costs).

[13]The assumptions that $h \leq 1/2$ and $b_i, b_j \in [0, 1]$ make sure that this ex post probability is positive and lower than one.

[14]We assume thus that "promotion" (advertising, famous cast, special effects, ...) has, as defined by Marshall (1919), a "combative role" as it helps studios steal each other's audience.

[15]Under this formulation, if the two movies are on show, the total number of views for the two movies at a given date t is given by $T_t \equiv Nt^{-\alpha}h(2 + (1 - \beta)(b_i + b_j))$. When movies are perfect substitutes ($\beta = 1$), $T_t = 2hNt^{-\alpha}$; with $h = 1/2$, we have that $T_t = Nt^{-\alpha}$, meaning that each viewer watches exactly one movie (the relative market share of each movie being determined by b_i and b_j). When movies are totally differentiated ($\beta = 0$),

We believe that our modelization of demand corresponds reasonably well to the reality. Our assumption of decay from the release date on mirrors the observation that "the first week accounts for almost 40% of total domestic box-office revenues on average" (Einav, 2007, p. 129). Einav also notes that "[t]he identity of the competing movies also matters when setting the release date. Distributors are wary of releasing a movie in close proximity to strong, popular movies." This echoes our assumptions that competition is stronger among movies of the same genre, and that a larger budget can raise the popularity of, and hence the demand for, a particular movie.

As explained above, we assume that budget and timing are the only strategic variables that studios control. Other variables, such as the period of exploitation of movies and ticket prices are typically decided by exhibitors, which we choose not to include in our model. Consequently, we assume that the period of exploitation of a movie is exogenously set to be equal to $s > 0$. As noted by Einav (2007, p. 130), "[t]ypically, a theater screens a movie for six to eight weeks." Regarding ticket prices, it is observed that they are generally uniform and relatively stable over time and across locations (see Orbach and Einav, 2007, and Chisholm and Norman, 2012). We therefore assume that the margin that a studio gets from each viewer of its movie is fixed and equal to $m > 0$. Hence, the profit of studio i at date t is given by

$$\pi_i\left(t, b_i, b_j\right) = \begin{cases} mhN\left(1 + b_i\right)t^{-\alpha} & \text{if } i \text{ is the only movie on show,} \\ mhN\left(1 + b_i - \beta b_j\right)t^{-\alpha} & \text{if both movies are on show.} \end{cases}$$

We see that profits are scaled by the constant mhN. Without any loss of generality, we can set $mhN = 1$ for the rest of the analysis. For the sake of simplicity, we assume that there is no discounting.[16] Finally, we assume that studios' objective is to maximize box-office revenues.[17] We can now express

---

$T_t = hNt^{-\alpha}\left(2 + b_i + b_j\right)$; with $h = 1/2$ and $b_i = b_j = 1$ (maximum promotion), we have that $T_t = 2Nt^{-\alpha}$, meaning that all viewers watch both movies.

[16]We can consider that discounting is already included in the decaying interest for movies over time.

[17]As Einav (2007, p. 130; emphasis added) explains: "Domestic box-office revenues now account for as little as 15% of the movie's revenues (down from about 35% in the early 1980s). Additional revenues are obtained from selling screening rights to cable and television networks, from the video and DVD markets, and from the international box-office market. However, higher domestic box-office revenues are believed to increase revenues in the ancillary markets. *Thus, maximizing domestic box-office revenues seems like*

the flow of profits for studio i as a function of the promotional efforts and release dates chosen by the two studios:

$$\pi_i\left(t_i, t_j\right) = \begin{cases} \pi_a \equiv \int_{t_i}^{t_i+s}\left(1+b_i\right)\tau^{-\alpha}d\tau \\ \qquad\qquad\qquad \text{if } 1 \leq t_i \leq \max\left\{t_j-s,1\right\}, \\ \pi_b \equiv \int_{t_i}^{t_j}\left(1+b_i\right)\tau^{-\alpha}d\tau + \int_{t_j}^{t_i+s}\left(1+b_i-\beta b_j\right)\tau^{-\alpha}d\tau \\ \qquad\qquad\qquad \text{if } \max\left\{t_j-s,1\right\} \leq t_i \leq t_j, \\ \pi_c \equiv \int_{t_i}^{t_j+s}\left(1+b_i-\beta b_j\right)\tau^{-\alpha}d\tau + \int_{t_j+s}^{t_i+s}\left(1+b_i\right)\tau^{-\alpha}d\tau \\ \qquad\qquad\qquad \text{if } t_j \leq t_i \leq t_j+s, \\ \pi_d \equiv \int_{t_i}^{t_i+s}\left(1+b_i\right)\tau^{-\alpha}d\tau \\ \qquad\qquad\qquad \text{if } t_j+s \leq t_i. \end{cases}$$

In segments π_a and π_d, studio i enjoys exclusivity, either because it releases its movie sufficiently before (π_a) or sufficiently after (π_d) studio j; note that segment π_a only appears if $t_j > 1+s$. In segments π_b and π_c, the exploitation periods of the two movies overlap, with movie i being released either before (π_b) or after (π_c) movie j.

We solve the game backwards for its subgame-perfect equilibria. Accordingly, we first consider the Nash equilibrium in terms of release dates for given budgets.

3.2   Release decision

We show here that only two equilibrium configurations are possible: either both studios release their movie at the very first date ($t_1^* = t_2^* = 1$) or one studio releases its movie immediately while the other studio waits for the end of the exploitation period to release its own, i.e., $t_i^* = 1$ and $t_j^* = 1+s$. We call the former configuration "simultaneous release" and the latter "staggered release". We establish this result with the help of the following two lemmas. (All proofs are mostly technical and are therefore relegated to the appendix.)

Lemma 1 *Studio i's best reponse to $t_j \geq 1$ is either $t_i^*\left(t_j\right) = 1$ or $t_i^*\left(t_j\right) = t_j + s$.*

According to Lemma 1, the best conduct for a studio is to release its movie either immediately or just after the other studio's movie ceases to

---

be shown. This result follows from the fact that segments π_a, π_b, and π_d decrease with t_i, while segment π_c reaches its largest value at one of the extremities of the zone where it is defined (i.e., at either $t_i = t_j$ or $t_i = t_j + s$).

We now show that if the other studio sufficiently delays the release of its movie, then it is best to release immediately.

Lemma 2 *If $t_j \geq 1 + s$, then studio i's best reponse is $t_i^*(t_j) = 1$.*

This result is very intuitive: if the other studio releases its movie after date $t = 1 + s$, it is possible to avoid upfront competition for the full exploitation period by releasing one's movie sufficiently earlier than the other studio does; morevoer, as interest decays with time, it is optimal to release the movie as soon as possible, i.e., at date $t = 1$.

While Lemma 1 suggested that four equilibrium configurations were possible (as each studio's reaction function is made of two dates), Lemma 2 discards one possibility: both firms releasing their movie at date $t = 1 + s$ cannot be an equilibrium. There does remain three possibilities: simultaneous release ($t_1^* = t_2^* = 1$) and staggered release ($t_1^* = 1$ and $t_2^* = 1 + s$, or $t_1^* = 1 + s$ and $t_2^* = 1$). To establish the conditions under which one or the other configuration emerges at equilibrium, we introduce the following pieces of notation:

$$
\begin{aligned}
v_1 &\equiv \int_1^{1+s} \tau^{-\alpha} d\tau = \begin{cases} \frac{(1+s)^{1-\alpha}-1}{1-\alpha} & \text{for } \alpha \neq 1, \\ \ln(1+s) & \text{for } \alpha = 1, \end{cases} \\
v_s &\equiv \int_{1+s}^{1+2s} \tau^{-\alpha} d\tau = \begin{cases} \frac{(1+2s)^{1-\alpha}-(1+s)^{1-\alpha}}{1-\alpha} & \text{for } \alpha \neq 1, \\ \ln(1+2s) - \ln(1+s) & \text{for } \alpha = 1. \end{cases}
\end{aligned}
$$

These values should be interpreted as follows: recalling that mNh is set equal to 1, v_1 (resp. v_s) is the expected profit for a movie released at date $t = 1$ (resp. $t = s$) when is the only one on screen during the whole exploitation period and when budgets are zero. Naturally, as interest for movies decays over time, we have that $v_1 > v_s$. It is also clear that both v_1 and v_s decrease with α: as demands decays faster, the cumulated audience decreases. Also, the ratio v_s/v_1 decreases with α.

Suppose that $t_j = 1$. Then studio i's best response is to choose $t_i = 1$ if and only if $\pi_b(1,1) \geq \pi_c(1+s,1)$, or

$$
\begin{aligned}
\int_1^{1+s} (1 + b_i - \beta b_j)\, \tau^{-\alpha} d\tau &\geq \int_{1+s}^{1+2s} (1 + b_i)\, \tau^{-\alpha} d\tau \Leftrightarrow \\
(1 + b_i - \beta b_j)\, v_1 &\geq (1 + b_i)\, v_s \Leftrightarrow \\
(1 + b_i)\, \beta_0 &\geq \beta b_j,
\end{aligned}
$$

where $\beta_0 \equiv 1 - v_s/v_1$. It is easy to see that the latter inequality is always satisfied if $\beta \leq \beta_0$.[18] We can therefore already conclude that when the two movies are not too similar (i.e., when $\beta \leq \beta_0$), simultaneous release is the only equilibrium configuration for any pair of promotional efforts.

When movies are closer substitutes (i.e., when $\beta > \beta_0$), then four equilibrium configurations are possible, as illustrated in Figures 1 to 3 and characterized in the next proposition.[19]

Proposition 1 *(1) For $\beta \leq \beta_0 = 1 - (v_s/v_1)$, $(t_1^*, t_2^*) = (1,1)$ for all b_1, $b_2 \in [0,1]^2$. (2) For $\beta_0 < \beta < 2\beta_0$, we have $(t_1^*(b_1,b_2), t_2^*(b_1,b_2)) \in$*

$$
\begin{cases}
\{(1,1)\} & \text{if } \frac{\beta}{\beta_0} b_2 - 1 \leq b_1 \leq \frac{\beta_0}{\beta}(1 + b_2), \\
\{(1, 1+s)\} & \text{if } b_1 \geq \frac{\beta_0}{\beta}(1 + b_2), \\
\{(1+s, 1)\} & \text{if } b_1 \leq \frac{\beta}{\beta_0} b_2 - 1.
\end{cases}
$$

(3) For $\beta > 2\beta_0$, we have $(t_1^*(b_1,b_2), t_2^*(b_1,b_2)) \in$

$$
\begin{cases}
\{(1,1)\} & \text{if } \frac{\beta}{\beta_0} b_2 - 1 \leq b_1 \leq \frac{\beta_0}{\beta}(1 + b_2), \\
\{(1, 1+s)\} & \text{if } b_1 \geq \max\left\{ \frac{\beta}{\beta_0} b_2 - 1, \frac{\beta_0}{\beta}(1 + b_2) \right\}, \\
\{(1+s, 1)\} & \text{if } b_1 \leq \min\left\{ \frac{\beta}{\beta_0} b_2 - 1, \frac{\beta_0}{\beta}(1 + b_2) \right\}, \\
\{(1, 1+s), (1+s, 1)\} & \text{if } \frac{\beta_0}{\beta}(1 + b_2) \leq b_1 \leq \frac{\beta}{\beta_0} b_2 - 1.
\end{cases}
$$

We see from Proposition 1 and Figure 2 that staggered release ($t_i^* = 1$, $t_j^* = 1 + s$) requires two conditions: on the one hand, the two movies must be sufficiently similar ($\beta > \beta_0$) and, on the other hand, the studios must have chosen relatively dissimilar budgets. To be more precise, a studio may

---

[18]The RHS is an increasing function of β, implying that the inequality is the hardest to meet when $\beta = \beta_0$; yet, in this case, it boils down to $1 + b_i - b_j \geq 0$, which is satisfied as, by definition, b_i and b_j are comprised between 0 and 1.

[19]Krider and Weinberg (1998) reach a similar result using a slightly different timing game.
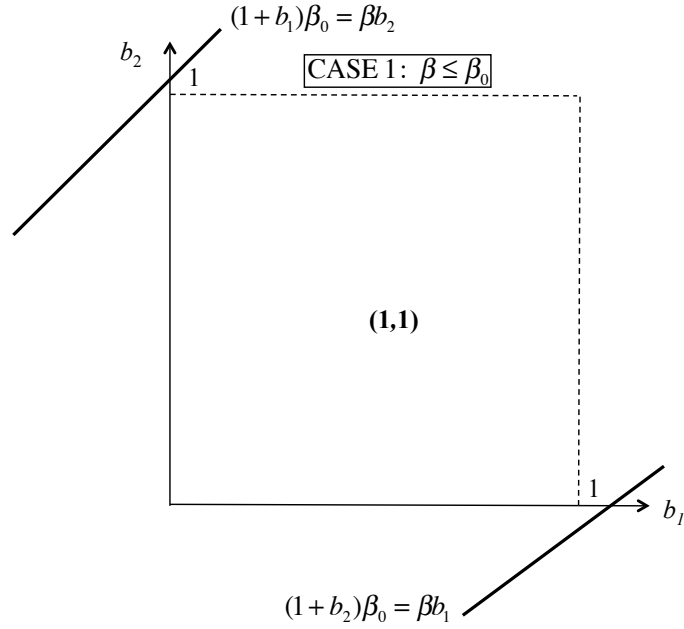
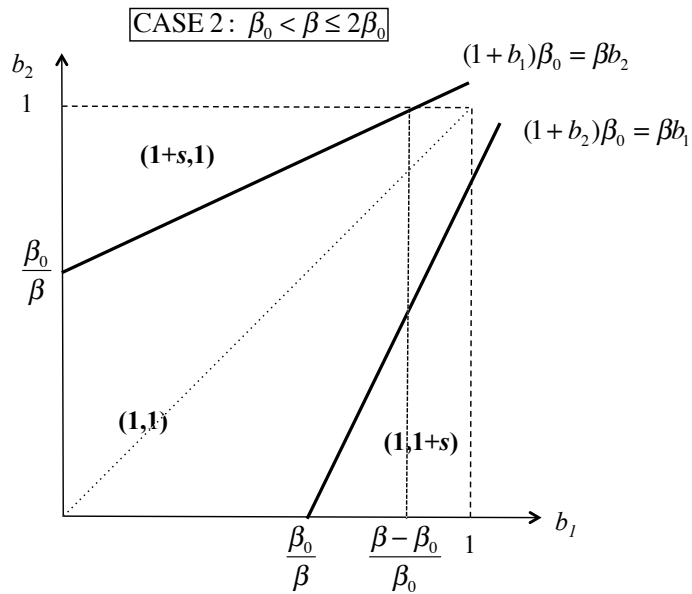Figure 1: Equilibrium release dates for $\beta \leq \beta_0$

Figure 2: Equilibrium release dates for $\beta_0 < \beta \leq 2\beta_0$
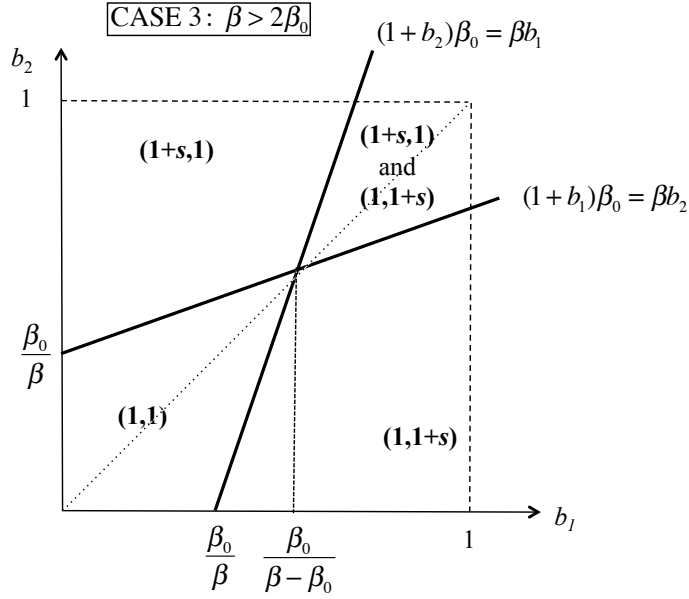
14

Figure 3: Equilibrium release dates for $\beta \geq 2\beta_0$

force the rival to postpone the release of its movie by choosing a budget that is sufficiently larger than the rival's. The required difference in budgets becomes smaller as movies become closer substitutes. At some point ($\beta > 2\beta_0$), staggered release may occur at equilibrium even if both studios choose the same budget; in that case, the similarity between the movies is so large that avoiding simultaneous release is the main motivation for both studios, resulting in the coexistence of the two staggered equilibria.

The results of Proposition 1 are consistent with what Einav (2007, p. 129) concludes from his observation of the US motion picture industry: "The two important considerations for the release date are the strong seasonal effects in demand and the competition that will be encountered throughout the movie's run. Typically, movies with higher expected revenues are released on higher (perceived) demand weekends, and there is a tradeoff between the seasonal and the competition effects." We now turn to the first stage of the game.

15

3.3 Budgeting decision

Our goal is to analyze how studios choose the budget for their movie, anticipating the equilibrium release dates that will ensue. We assume that costs are convex: $C(b_i) = (\gamma/2) b_i^2$, where $\gamma > 0$ is an inverse measure of the efficiency of the (movie production and promotion) technology. If $\beta \leq \beta_0$, the first stage is extremely simple as a unique equilibrium obtains in the second stage. Firm i chooses its budget b_i to maximize $(1 + b_i - \beta b_j) v_1 - (\gamma/2) b_i^2$. The optimum is $b_i = v_1/\gamma$. To guarantee $b_i \leq 1$, we assume that $\gamma > v_1$. At the other extreme, when $\beta > 2\beta_0$, a full characterization of the first-stage equilibrium is not possible as there exist couples (b_1, b_2) leading to subgames where multiple equilibria obtain, meaning that studios cannot predict the ensuing equilibrium release dates. In what follows, we rule out this case by assuming that $2\beta_0 \geq 1$. We show in Appendix 6.3 that this assumption is consistent with the observation that the first week of exploitation of a movie accounts, on average, for almost 40% of the total box-office revenues (Einav, 2007, p. 129). We therefore focus here on the case where $\beta_0 < \beta \leq 1$.

3.3.1 Equilibrium with simultaneous release

If simultaneous release is the second-stage equilibrium, the studios invest $b_1 = b_2 = v_1/\gamma$ and there profits are

$$\pi_1^{im} = \pi_2^{im} = \left(1 + (1 - \beta) \frac{v_1}{\gamma}\right) v_1 - \frac{\gamma}{2} \left(\frac{v_1}{\gamma}\right)^2.$$

Two conditions are needed for this to be a subgame-perfect equilibrium. First, it must be that $(b_1, b_2) = (v_1/\gamma, v_1/\gamma)$ does indeed lead to $(t_1, t_2) = (1, 1)$ in the second stage. We see from Figure 2 that this is always true for $\beta_0 < \beta \leq 1$ as the main diagonal is included in the area where $(t_1, t_2) = (1, 1)$ is the second-stage equilibrium.

The second condition is that no firm finds it profitable to trigger a change of second-stage equilibrium from simultaneous to staggered release. Without loss of generality, consider studio 1. If the second-stage equilibrium is $(1, 1 + s)$, then studio 1's maximization program is $\max_{b_1} (1 + b_1) v_1 - (\gamma/2) b_1^2$. So, the unconstrained optimum is v_1/γ but this value does not satisfy the constraint that must be met to be in the $(1, 1 + s)$ zone.[20] So,

---

[20]We need $\beta b_1 \geq (1 + b_2) \beta_0$. With $b_1 = b_2 = v_1/\gamma$, the condition becomes $v_1/\gamma \geq \beta_0/(\beta - \beta_0)$, which is impossible under our assumptions that $\beta < 2\beta_0$ and $v_1/\gamma < 1$.

studio 1 chooses the smallest value of b_1 that meets the constraint, i.e.,

$$b_1^d = \frac{\beta_0}{\beta}\left(1 + \frac{v_1}{\gamma}\right).$$

The corresponding profit is computed as

$$\pi_1^d = \left(1 + \frac{\beta_0}{\beta}\left(1 + \frac{v_1}{\gamma}\right)\right)v_1 - \frac{\gamma}{2}\left(\frac{\beta_0}{\beta}\left(1 + \frac{v_1}{\gamma}\right)\right)^2.$$

Comparing π_1^{im} and π_1^d allows us to state the following result.

Lemma 3 *Suppose that $\beta_0 < \beta \leq 1$. The subgame-perfect equilibrium is $(b_1^*, b_2^*; t_1^*, t_2^*) = (v_1/\gamma, v_1/\gamma; 1, 1)$, involving simultaneous release, if and only if*

$$\frac{v_1}{\gamma} \leq \beta_0 \frac{\beta\sqrt{2\beta} - \beta + \beta_0}{\beta^2(2\beta - 1) + \beta_0(2\beta - \beta_0)}. \tag{2}$$

It is clear that the LHS of condition (2) decreases if v_1 decreases (which can result from an increase in α) or if γ increases. As for the RHS, simple derivations show that it increases if β decreases or if β_0 increases. Recalling that $\beta_0 = 1 - v_s/v_1$, we have that an increase in β_0 is caused by a decrease in the ratio v_s/v_1 (which can itself be caused by an increase in α). We can therefore conclude that an equilibrium with simultaneous release is more likely (i) the larger γ, (ii) the smaller β, and (iii) the larger α. All these results confirm the intuition: (i) if it is more costly to produce and promote a movie (larger γ), forcing the rival to delay the release of its movie becomes less profitable; (ii) if movies are less similar (smaller β), sharing the screen hurts less; (iii) if viewership decays faster (larger α), simultaneous (i.e., earlier) release is more attractive even if it implies sharing the screen.

3.3.2 Equilibrium with staggered release

Suppose that studio 1 releases its movie at $t_1 = 1$, and studio 2 at $t_2 = 1 + s$. As long as these release dates are maintained, it is easily seen that the two studios will choose their budget as $(b_1, b_2) = (v_1/\gamma, v_s/\gamma)$, leading to the following profits:

$$\pi_1^{st} = \left(1 + \frac{v_1}{\gamma}\right)v_1 - \frac{\gamma}{2}\left(\frac{v_1}{\gamma}\right)^2,$$

$$\pi_2^{st} = \left(1 + \frac{v_s}{\gamma}\right)v_s - \frac{\gamma}{2}\left(\frac{v_s}{\gamma}\right)^2.$$

For these strategies to be part of a subgame-perfect equilibrium, it must first be the case that the budgets $(b_1, b_2) = (v_1/\gamma, v_s/\gamma)$ generate $(1, 1 + s)$ as second-stage equilibrium. Using Proposition 1, we see that this is so as long as

$$\frac{v_1}{\gamma} \geq \frac{\beta_0}{\beta} \left(1 + \frac{v_s}{\gamma}\right). \tag{3}$$

Second, we must check that no studio has an incentive to choose a budget that would lead to another second-stage equilibrium. It is first easy to show that the studio that releases its movie first does not have any profitable deviation. This result is not surprising as releasing its movie at date $t = 1$ and facing no competition appears as the best possible scenario for a studio. Consider now the studio that releases its movie at date $t = 1 + s$ (studio 2 here). Referring to Figure 2, we see that two deviations are theoretically possible: studio 2 can change the equilibrium release dates either to $(1, 1)$ or to $(1 + s, 1)$. However, we show in the appendix that the latter option is never feasible. As for the deviation to $(1, 1)$, we show that it is not only feasible but it can also be profitable. To make this deviation not profitable, condition (4) must be imposed, which is more stringent than condition (3). The next lemma summarizes our results.

Lemma 4 *Suppose that $\beta_0 < \beta \leq 1$. The subgame-perfect equilibrium is $\left(b_i^*, b_j^*; t_i^*, t_j^*\right) = (v_1/\gamma, v_s/\gamma; 1, 1 + s)$, involving staggered release, if and only if*

$$\frac{v_1}{\gamma} \geq \frac{2\beta_0}{\beta_0^2 + 2(\beta - \beta_0)}. \tag{4}$$

In terms of comparative statics, we expect the opposite results than in the previous case: the factors that make staggered release more likely should be those that make simultaneous release less likely. That is, staggered release should be more likely if (i) producing a movie is less costly, (ii) movies are closer substitute, and (iii) viewership does not decay too fast. The first conjecture is clearly verified: if γ decreases, the LHS of condition (4) increases, which makes the condition more likely to be satisfied. The second and third conjectures are also verified. Note first that as we assume that $\gamma > v_1$, condition (4) can only be satisfied if its RHS is smaller than unity. Some lines of computations establish that two necessary conditions are $\beta_0 < 2 - \sqrt{2} \simeq 0.586$ (which is equivalent to $v_s/v_1 \geq \sqrt{2} - 1 \simeq 0.414$) and $\beta > (\beta_0/2)(4 - \beta_0)$; that is, staggered release can only emerge if demand

18

does not decay too fast and if movies are similar enough. Moreover, one also observes that the RHS of condition (4) decreases with β and increases with β_0, which reinforces the previous findings.

Combining Lemmata 3 and 4, we can now fully characterize the subgame-perfect equilibrium (in pure strategies) of the two-stage game.

Proposition 2 *Suppose that studios choose first the budget for their movie and then decide when to release it. The subgame-perfect equilibrium (in pure strategies) of this game is as follows. (1) If $\beta \leq \beta_0$ or if $\beta_0 < \beta \leq 1$ and condition (2) is satisfied, then both studios invest v_1/γ and release their movie immediately. (2) If $\beta_0 < 2 - \sqrt{2}$, $(\beta_0/2)(4 - \beta_0) < \beta \leq 1$ and condition (4) is satisfied, then one studio invests v_1/γ and releases its movie immediately, while the other studio invests $v_s/\gamma < v_1/\gamma$ and releases its movie just after the showing of the first movie ends.*

Figure 4 depicts the results for $\beta_0 < \beta \leq 1$. It can be shown that the RHS of condition (4) is always larger than the RHS of condition (2), as represented on Figure 4. Hence, there exist configurations of parameters where a subgame-perfect equilibrium in pure strategies fails to exist. This corresponds to intermediate values of v_1/γ; that is, values of v_1/γ that are too large for simultaneous release to prevail (e.g., because production and promotion are rather cheap, which induces studios to invest more so as to force the other studio to delay), and too small for staggered release to prevail (e.g., because viewership is too condensed on the first weeks of exploitation). This potential absence of pure-strategy equilibria can be seen as an indication of the instability of competition on the movie market.

4   Empirical analysis

The main testable empirical hypothesis that we can draw from our model is that studios may decide to increase their budget as a way to secure release close to demand peaks and discourage their rivals from doing the same. We should therefore observe that:

(H1) *Higher budgets explain release dates closer to demand peaks.*

The model also shows that the interplay between budgets and release dates strongly depends on the degree of substitutability between the movies:
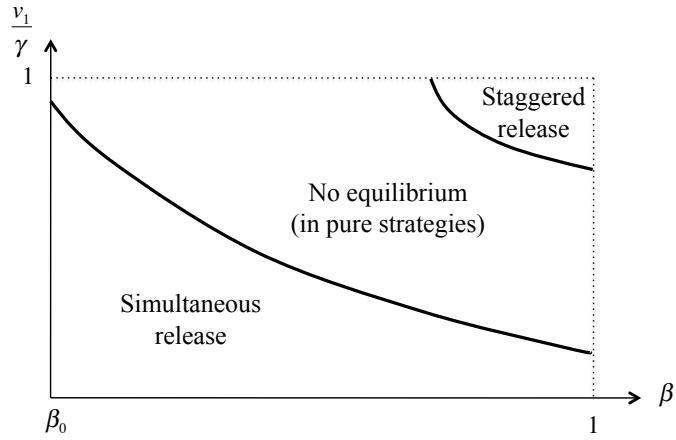
Figure 4: Subgame-perfect equilibrium (in pure strategies)

the more similar the movies, the higher the incentive to increase the budget so as to secure the earliest release date. We can thus derive the following hypothesis:

(H2) *The release date of a given movie is more sensitive to the budgets of close competitors (movies of the same genre) than of distant competitors (movies of other genres).*

Finally, the model also suggests that studios set the same high budget in the simultaneous release equilibrium, while they set different budgets in the staggered release equilibrium (with the follower investing less). This finding leads us to formulate a third hypothesis:

(H3) *The distribution of budgets is characterized by both a higher mean and a higher standard deviation in weeks closer to a demand peak.*

We now want to test these hypotheses in depth on our entire data set. In the rest of this section, we first describe the data that we use to perform our empirical analysis; we then present our empirical strategy and finally, we describe our results.

4.1 Data

The data (collected on the website *Box Office Mojo*) refers to American movies released in ten countries[21] between January 1, 2001 and December 31, 2013 for which production budgets are available. Our final database comprises 1564 movies and 12.904 valid observations (see Table 3). For each of the 1564 movies, we know (i) the production budget, (ii) the official release dates (for the countries where the movie was released), (iii) the genre to which the movie belongs, and (iv) whether or not the movie is a sequel of (a) previous movie(s).

Two comments are in order regarding the data. First, the "production budget refers to the cost to make the movie and it does not include marketing or other expenditures."[22] This can be seen as a limitation to test our hypotheses. In our model, we consider indeed budgets as instruments to attract more viewers and, arguably, the main channel to do so is to increase marketing and advertising expenditures. We believe, however, that production budgets are a reasonable proxy for our purposes. As argued in Section 3.1, the production budget comprises expenditures (such as cast, director, special effects, ...) that are as relevant as marketing expenditures to increase the expected viewership of a movie. Moreover, it is generally estimated that marketing budgets tend to represent a constant proportion (about 50%) of production budgets.[23]

Second, to form sub-samples of relatively comparable sizes, we have grouped movies in five main "genres", namely *Drama*, *Action*, *Suspense*, *Comedy*, and *Other*. [24]

Tables 1 and 2 provide some descriptive statistics of the major variables. In Table 1, we report the main characteristics of the 1546 movies in our sample. The mean and standard deviation of the (inflation-adjusted) production budgets are $54.4 million and $53.1 million, respectively. Comparing movie

---

[21]Australia, France, Germany, Italy, Japan, New Zealand, South Africa, Spain, USA/Canada, and United Kingdom.

[22]See `www.boxofficemojo.com/about/boxoffice.htm`.

[23]See `http://en.wikipedia.org/wiki/Film\_promotion` or `http://entertainment.howstuffworks.com/movie-cost1.htm`.

[24]*Drama* corresponds to the Mojo category 'Drama', *Action* merges the Mojo categories 'Action', 'Adventure', and 'Western', *Suspense* merges the Mojo categories 'Thriller/Suspense' and 'Horror', *Comedy* merges the Mojo categories 'Comedy', 'Romantic Comedy', 'Black Comedy' and 'Cartoons', and *Other* merges the Mojo categories 'Musical, 'Documentary', and 'Concert/Performance'.

		Obs	%	Mean	Std. Dev.	Min	Max
	Drama	378	25	30.6	29.3	0.17 (Once)	206.34 (A Christmas Carol)
	Action	417	25	100.9	66.3	4.85 (Night Watch)	336.9 (Pirates of the Caribbean: At World's End)
Genre	Suspense	262	17	36	31.7	0.16 (Paranormal Activity)	170.88 (Inception)
	Comedy	463	29	45.4	38.4	0.19 (Tadpole)	200 (Monsters University)
	Others	44	4	23.5	28.3	0.08 (Super Size me)	96.12 (The Nutcracker)
Sequel		194	12	95.9	73.6	2.46 (Before Sunset)	336.9 (Pirates of the Caribbean: At World's End)
Titles		1564	100	54.4	53.1	0.08 (Super Size me)	336.9 (Pirates of the Caribbean: At World's End)

Table 1: Production budgets per genre

Country	Obs	% wrt titles	Average budget	Std. Dev.
US / Canada	1564	100%	54.4	53.1
Australia	1374	88%	58.7	55.5
France	1316	84%	60,0	55.3
Germany	1337	85%	59.7	55,0
Italy	1308	84%	60.1	55.2
Japan	798	51%	78.8	60,0
N. Zealand	1223	78%	61.8	56.4
S. Africa	1152	74%	64.2	56.5
Spain	1401	90%	58.2	54.3
UK	1431	91%	56.9	54.2
Total	12904			

Table 2: Production budgets per country of release

genres, we observe that movies in the Action category present the highest mean and standard deviation for the production budgets. We also observe in Table 2 that the market for American movies varies in size across countries. Only a little more than 50% of the American movies in our sample are released in Japan, while this proportion is at least as large as 73% in the other countries. Interestingly, the average production budget is larger for movies released outside the U.S and Canada, suggesting that studios choose not to release small-budget movies abroad (probably because they fear that they will not be profitable enough).

Casual observation of our data lends credence to our hypotheses, as illustrated by Figure 5. This figure plots release dates (on the horizontal axis) against production budgets (on the vertical axis) for movies released in the US/Canada in 2008; each dot corresponds to one movie and the color of the dots indicates to which genre the movie belongs; the vertical lines
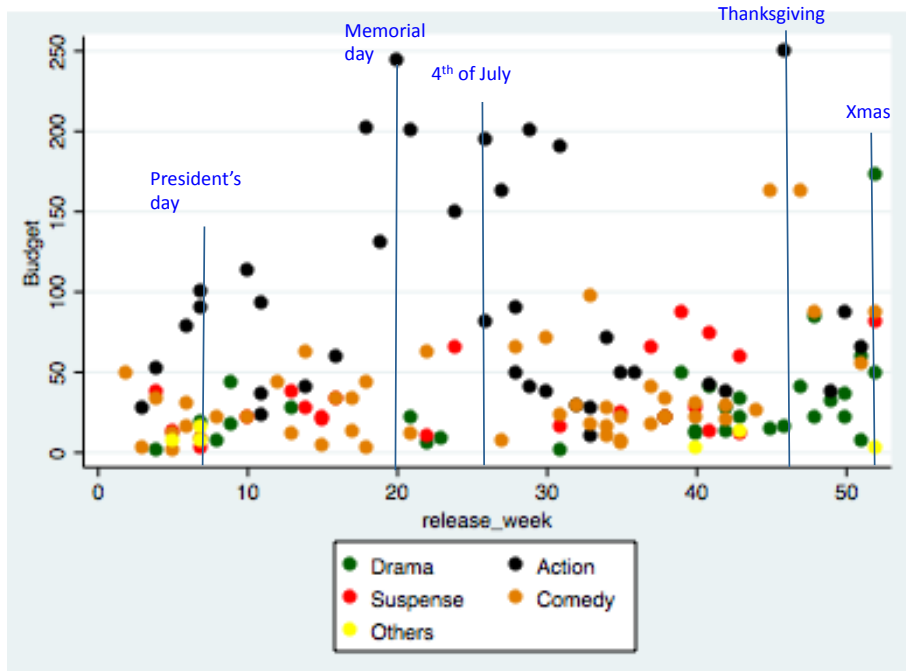
Figure 5: Budgets per week and per genre (USA, 2008)

correspond to the seasonal peaks. We observe that the movies with the larger budgets are indeed released close to the peaks; we also see that when several movies are released close to a peak, they usually belong to different genres and have different budgets (the dots have different colors and are scattered).

4.2 Specification and results

In the theoretical model of Section 3, we assumed for simplicity that everything was starting at some date $t = 1$, corresponding to a peak in demand. In this context, we modeled the trade-off facing studios as choosing between meeting the demand (i.e., immediate release) and avoiding head-to-head competition (i.e., delayed release). In reality (as illustrated in the introduction), there is another way to avoid competition, which is to release a movie *before* the peak. In our empirical model, we thus need to consider a symmetric version of our theoretical model, where movies can be released at a peak or any time before and after. Accordingly, we define our dependent

variable as the *number of weeks (in absolute value) between the release date of a movie and the closest demand peak*:

$$t_{ik} = min \left| peakweek_k - releaseweek_{i,k} \right|,$$

where i identifies the movie and k the country.[25]

4.2.1 Seasonal peaks

We identify the seasonal peaks in the demand for movies in the various countries using the following three-step procedure. First, following Mojo, we consider five seasons: Winter, Spring, Summer, Fall, and the Holiday Season.[26] Second, we use the weekly box office revenue data in each country to find the share of each week's revenues in the total annual revenues. Third, we define a peak as a week that reaches a sum of box-office revenues that is above the 70th percentile of the seasonal distribution. Table 4 in Appendix 6.7 reports the weeks identified as peaks (by season and by country); note that it is not rare that two or three consecutive weeks qualify as peaks.

Clearly, this procedure raises an endogeneity issue for our estimations as shares are equilibrium outcomes that depend both on demand and supply behavior. Take for instance the summer period. Two reasons may explain why box-office revenue are higher during this period: people may be more willing to go to the movies because they are on vacation or long for air-conditioning (demand effect) and/or because it is precisely the period when studios have decided to release their more popular movies (supply effect). In other words, it is not clear whether it is the box-office revenue that drives

---

[25]By taking the absolute value, we implicitly assume that studios find it equivalent to release a movie x weeks before or x weeks after a given peak. Arguably, it may be more profitable to release a movie before a peak rather than after as the movie will still be on screen when the demand is the highest (even if the attractiveness of the movie itself will have faded). On the other hand, there may be very little demand in the weeks immediately preceding a peak; think, e.g., of the last week of June, preceding the peak of the 4th of July in the US. As these forces may counterbalance each other, we believe that our assumption of symmetry around a peak is reasonable. However, we plan to investigate this issue further in future research.

[26]*Winter* goes from the first day after New Year's week or weekend through the Thursday before the first Friday in March; *Spring* goes from the first Friday in March through the Thursday before the first Friday in May; *Summer* goes from the first Friday in May through USA Labor Day Weekend; *Fall* goes from the day after USA Labor Day Weekend through the Thursday before the first Friday in November; the *Holiday Season* goes from the first Friday in November through New Year's week or weekend.

the choice of release dates, or the other way round. Yet, we have two reasons to believe that endogeneity is not a real concern in our case. First, previous research has shown that the demand effect largely dominates.[27] Second, by summing box-office revenues for a particular week over 13 years (or less, depending on data availability), we reduce (if not eliminate) any endogeneity problem that may exist. Reassuringly, we find the same pattern of movie sales as Einav (Figure 4, p. 139, 2007) for US/Canada, and as Hand and Judge (Figure 2, p. 83, 2011) for UK data (see Figures 8 and **??** in Appendix 6.7).

4.2.2 Test of hypotheses (H1) and (H2)

To estimate the effects of production budgets and competition on the release date of a movie, we estimate the following specification:

$$t_{ik} = \alpha_k + T_{ik} + \beta_1 budget_i + \beta_2 n_{ik} + \beta_3 m_{ik} + \beta_4 sequel_i + \beta_5 X_{i,k} + \varepsilon_{ik}, \quad (5)$$

where the indices i and k refer, respectively, to movies ($i = 1 \ldots 1564$) and countries ($k = 1 \ldots 10$), α_k is a country fixed effect, T_{ik} is a dummy for the year of release in country k, $budget_i$ is the production budget of film i, n_{ik} (resp. m_{ik}) is the sum of the production budgets of other movies of the same (resp. a different) genre as movie i and released during the the same week as movie i in country k, $sequel_{ik}$ is a dummy variable that takes value one if movie i is a sequel of a previously released movie, and $X_{i,k}$ is a matrix of controls (season, year and country). The variable $sequel_{ik}$ is meant to capture the fact that sequels benefit from the popularity acquired by the previous movies in the same series, which may scare off the competition by itself, regardless of the size of the production budget.

Recalling that a *decrease* in t_{ik} means that the release date moves *closer* to the nearest peak, the theoretical prediction stated in hypothesis (H1) lead us to expect a negative value for β_1 (a higher budget is used as a commitment to release near a demand peak, implying a smaller t_{ik}), and negative values for β_2 and β_3 (an increase in the total budgets of contemporaneous movies is taken as a proxy for an increase in the competitive pressure, which should

---

[27]Einav (2007) disentangles the endogeneity implicit in the data for the US movie market and finds that the behavior of demand accounts for about two-thirds of the seasonal variation in total sales. Hand and Judge (2011) find the same evidence for the UK market, using monthly cinema admissions data.

lead the studio to release the movie closer to the peak, i.e., to a smaller t_{ik}).
Moreover, according to hypothesis (H2), we should observe $|\beta_2| > |\beta_3|$, as
the competitive pressure stemming from movies of the same genre should
be felt more strongly.

We report the results of the OLS estimation of specification (5) in the
first two columns of Table 3, with the variables n_{ik} and m_{ik} being excluded
in Column (1). We see that in both specifications, β_1, β_2, and β_3 have all
the expected sign and are statistically significant at the 1% level. We also
observe in the second specification that $|\beta_2| > |\beta_3|$; that is, the aggregate
budgets of movies in the same genre (n_{ik}) exert a stronger effect on the
release date of a given movie, compared to the aggregate budgets of all the
other movies (m_{ik}). A t-test conducted between the two variables confirms
that the difference is statistically different from zero at the 1% level. We
can thus safely say that hypotheses (H1) and (H2) are verified.

Noteworthy is the fact that the coefficient of the variable $sequel_{ik}$ is
never significant. We interpret this finding as follows: even if sequel movies
may benefit from a head start in terms of popularity, releasing them near de-
mand peaks still requires studios to increase their production and promotion
budgets.[28]

4.2.3   Robustness checks

We check the robustness of our results in two different ways. First, we pro-
pose a Poisson regression model (Maddala, 1983). Poisson distributed data
is intrinsically integer-valued, which makes sense for count data as in our
case. Since the dependent variable has a restricted support, OLS regression
could predict values that are negative and non-integer values, which have no
sense. Furthermore, OLS assumes that true values are normally distributed
around the expected value. So, Poisson regression models perform better in
far from normal distributed data. We present the results of this estimation
in the third column of Table 3. We observe that the Poisson regression of
Column (3) and the OLS regression of Column (2) give very similar results.

As a second robustness check, we modify our dependent variable by iden-
tifying demand peaks in a different way: a week is now defined as a peak if

---

[28]We observe in Table 1 that sequel movies are characterized by rather large budgets:
the mean budget for sequel movies is \$95.9 million, whereas the mean budget for all movies
in our sample is \$54.4 million.

	(1)	(2)	(3)	(4)
	OLS	OLS	Poisson	OLS (yearly peaks)
budget	-0.0028 ***	-0.0037 ***	-0.0015 ***	-0.0067 ***
	(-6.08)	(-7.88)	(-7.79)	(-8.56)
Sequel	0.286	-0.0054	-0.011	-0.044
	(0.45)	(-0.09)	(-0.05)	(0.41)
n_ik		-0.0037 ***	-0.0015 ***	-0.0065 ***
		(-7.88)	(-7.30)	(-8.35)
m_ik		-0.0029 ***	-0.001 ***	-0.0055 ***
		(-11.62)	(-10.00)	(-12.09)
drama	0.31 **	0.28 **	0.114 **	-0.956
	(2.52)	(2.26)	(2.25)	(-0.43)
action	0.205	0.158	0.684	0.505 **
	(1.27)	(1.23)	(1.30)	(2.20)
suspense	0.492 ***	0.399 ***	0.152 ***	0.496 **
	(3.86)	(3.13)	(2.96)	(2.18)
comedy	0.164	0.133	0.54	0.399 *
	(1.33)	(1.08)	(1.07)	(1.80)
others	(omitted)	(omitted)	(omitted)	(omitted)
Constant	1.917 ***	2.411 ***	0.839 ***	4.6 ***
	(13.15)	(16.03)	(13.57)	(18.01)
Season, Year and Controls	YES	YES	YES	YES
Country Fixed Effects	YES	YES		YES
R-squared	0.1077	0.1195		0.1058
Adj R-squared	0.1056	0.1173		0.1039
Pseudo R-squared			0.0309	
Prob > chi2			0.000	
Number of observations	12904	12904	12904	12904

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$

Table 3: Estimation results

it reaches a sum of box-office revenues that is above the 70th percentile of the distribution of a given *year* instead of a given *season*. This changes the distribution of peaks in two conflicting ways: when compared over a whole year, some 'big' weeks within 'small' seasons go out (e.g., in the spring), whereas some 'big' weeks within 'big' seasons come in (e.g., in the summer). These changes are depicted for each country in Table 5 in Appendix 6.7. We regress the newly defined dependent variable over the same set of independent variables as in specification (5). The results are reported in the fourth column of Table 3. We observe that all the coefficients of interest continue to have the expected sign and remain highly significant. The relationship between budgets and release dates seems thus to exist irrespective of the way we define the demand peaks. This also suggests that studios compete in terms of release dates not only within each season but also over the whole year.

4.2.4 Test of hypothesis (H3)

As suggested in Figure 5, the distribution of movie budgets seems to vary a lot week per week. In particular, for weeks at or near a demand peak, the largest budget is higher and the distribution is more dispersed. This observation is consistent with the predictions of our model: higher budgets allow studios to release their movies closer to a peak and to scare off the competition. It is thus unlikely to observe two movies with high budgets released around a peak (especially if they belong to the same genre). As a result, movies coexisting in weeks near a peak should have very dissimilar budgets (very high or very low). Conversely, in weeks further away from peaks, the distribution of budgets should be more concentrated and with a lower mean.

To check this hypothesis, we have categorized movies (across countries and years) according to the number of weeks that separate their release from the nearest peak. We have then computed the mean and the standard deviation of the production budgets for the movies within each category. To verify hypothesis H3, we should observe that both the mean and the standard deviation decrease as we move to categories of movies that are more distant from a peak.

Figure 6 plots the mean of the standard deviation of the production budgets (vertical axis) against the number of weeks separating the release
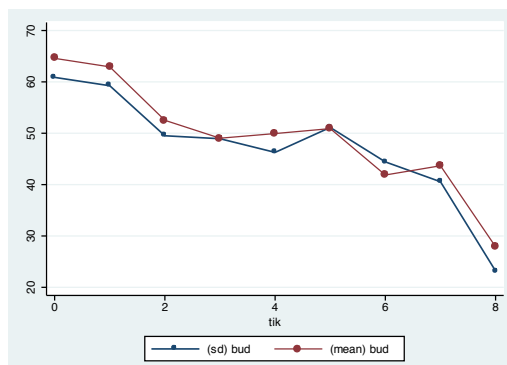
Figure 6: Mean and standard deviation of budgets according to release date

date from the nearest peak (horizontal axis); the latter variable takes values from 0 to 9. As expected, we observe that both variables decrease as movies are released further from a peak. This observation suggests that hypothesis H3 is verified.

4.3 Discussion

We discuss here a number of concerns that our approach could raise. We also indicate how we have already addressed some of them and how we plan to address others in future work.

Movies released by the same studio. Major film studios (Warner, Walt Disney, Universal, Columbia TriStar, Fox or Paramount) typically release about 15 to 20 movies per year. Inevitably, several movies are then released within a given season, and these movies may be of the same genre and have similar budgets. This is illustrated on Figure 7, which depicts the movies that 20th Century Fox released in the U.S. in 2008 (weeks are reported on the horizontal axis and genres on the vertical axis; the size of a dot is proportional to the size of the budget of the corresponding movie).

Clearly, each studio coordinates the budget and release decisions for its movies. We need thus to assess how this possibility affects our analysis. From a theoretical viewpoint, we can analyze the promotion and release decisions of a monopoly studio that produces and distributes two movies, and compare the results to the ones that we obtained in the duopoly model of Section 3. In Appendix 6.6, we show that simultaneous release emerges
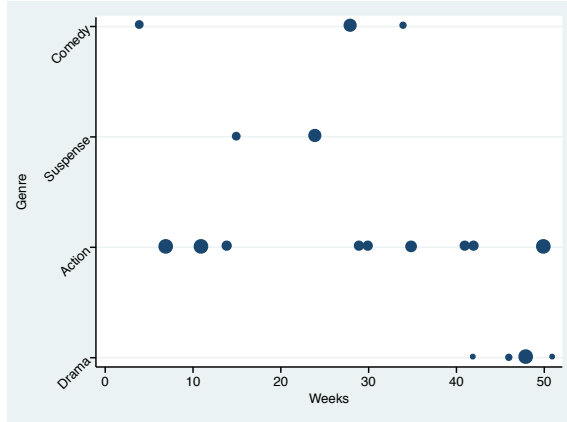
Figure 7: Movie releases by Fox in the U.S. in 2008

for a wider configuration of parameters under a multi-movie monopoly than under a duopoly. Moreover, when the monopoly studio decides to release both movies at date $t = 1$, we show that it chooses a lower budget than independent studios do (i.e., $b_i = (1 - \beta)v_1/\gamma$ instead of $b_i = v_1/\gamma$). In contrast, when the monopoly studio opts for staggered releases, the chosen dates and budgets are exactly the same as in the duopoly case. The previous analysis suggests that the difference between coordinated (i.e., multi-movie monopoly) and independent (i.e., duopoly) decisions should only be minor and observed for a restricted set of parameters. Moreover, if we transpose these results to an oligopoly setting, i.e., if we add to our setting the competition resulting from other (multi-movie) studios, the impact of coordinated decisions can only be weaker. We therefore believe that the fact that the same studio releases several movies during a given season does not affect our results in a significant way.

Rescheduling. In our model, studios choose the release date of their movie once-and-for-all at the start of the game. The choices are supposed to be simultaneous, which is to say that no studio can observe the choice of the other studio before making its own. This is clearly a simplification as in reality, it happens that studios modify their initial decision and reschedule the release of their movies. For instance, Einav (2010, p. 380) observes that in his dataset,[29] "more than 60% of the movies changed their release dates

---

[29]His dataset contains all movies released in the U.S. between 1985 and 1999.

at least once." Although some of these changes may be due to internal reasons (e.g., unforeseen production delays), it is widely believed that most of them are done for strategic reasons, i.e., as a reaction to current or expected competition. In support for this view, Dürr *et al.* (2014) estimate[30] that "movies which have been rescheduled and therefore observed the market conditions very carefully, were able to avoid competition and thus achieved better results at the box office." This finding suggests the presence of a second-mover advantage that our simple model fails to capture. Yet, the key concern for our analysis is whether sequential release decisions would challenge our result that higher production budgets are used to scare off competition and secure the most profitable release dates. Einav (2010, p. 380) gives us some reassurance in this regard by noting that: "The likelihood of a movie changing its release date is not significantly correlated with the movie's size, measured by its production cost." Our analysis appears thus as a reasonable approximation. It would, however, be interesting to enrich our theoretical model by allowing studios to change their release date at some cost.[31]

International differences. Our dataset spans 10 countries but focuses on the release of American movies only. As a result, in non U.S. markets, we miss the competition that (unobserved) popular local movies exert on (observed) American movies. As anecdotal evidence, it appeared that Chinese authorities delayed the release of *Skyfall* (the latest James Bond movie) by more than three months with respect to the original release date, because an earlier release could have overshadowed the release of two big-budget Chinese films.[32] To account for such local competition we should definitely extend our dataset. For now, the potential influence of local movies is picked up in our regressions by the country fixed effects. Countries also differ according to the distribution of peaks along the year (because holidays, weather conditions and/or patterns of movie consumption vary across countries). However, this does not affect our estimations as peaks are defined country

---

[30]Their dataset contains 634 movies released in the U.S. between 2007 and 2013.

[31]According to Einav (2010, p. 380), the costs associated with changing a release date can stem from "committed advertising slots, the implicit costs of reoptimizing the advertising campaign, reputational costs, etc."

[32]See `www.hollywoodreporter.com/news/skyfall-china-release-date-pushed-389769`, last consulted March 2015.

per country, which takes care of local specificities.

Definition of genres. The degree of substitutability across movies (measured by the parameter β) plays an important role in our theoretical model. We approach it in the empirical analysis by classifying movies into different genres. There are two potential weaknesses in this strategy. First, our classification may be a bit arbitrary as we have merged distinct MOJO genres to form categories of relatively equal sizes. Although we have merged genres that looked relatively similar, we are not sure that the degree of substitutability is always higher across than within our categories. Second, and perhaps more importantly, recent developments in the motion picture industry indicate that the boundaries between various genres may start to blur. In particular, genres that used to be rather immune to competition like animated films are increasingly facing the competition of other genres, for instance superhero films.[33] Although we have not done so, we could repeat our estimations under different groupings of the MOJO genres and find out whether hypothesis (H2) is still verified.

5 Concluding remarks

In this paper, we analyzed how movie studios can use strategically the size of the production budget of a movie to scare off competition so as to secure a release date close to a demand peak. To this end, we built a simple game-theoretic model where two studios compete along two dimensions: production budget and release date. We showed that two types of subgame-perfect equilibria can emerge: simultaneous release (both studios choose high production budgets and release their movie at the start of the period, which corresponds to the peak of demand) or staggered release (one studio chooses a high production budget and releases its movie at the start of the period, while the other studio chooses a lower budget and releases its movie later). The latter equilibrium is more likely when movies are close substitutes (e.g., because they belong to the same genre).

We then brought the model to the data (i.e., 1564 American movies released in 10 countries from 2001 to 2013). This allowed us to verify the

---

[33]See, e.g., `http://tinyurl.com/mdmqpdt` (last consulted March 2015) where Jeffrey Katzenberg explains how Marvel is Dreamworks new competition.

predictions that we could draw from the theoretical model, namely that (i) higher budgets explain release dates closer to a demand peak, (ii) release dates are more sensitive to the budgets of close competitors than of distant competitors, and (iii) the mean and standard deviation of the budget distribution are both higher in weeks closer to a demand peak.

Besides the extension already mentioned in the previous section, it would be interesting to examine in future research the extent to which our setting can be applied to other information goods for which release dates and production budgets also appear as strategic decisions. For instance, there are reasons to believe that the forces described in this paper are also at work in the book industry.[34]

6 Appendix

6.1 Proof of Lemma 1

We show that the segments π_a, π_b, and π_d decrease with t_i, while segment π_c reaches its largest value at one of the extremities of the zone where it is defined (i.e., at either $t_i = t_j$ or $t_i = t_j + s$).

$$\pi_a' = \pi_d' = (1 + b_i) \left(-t_i^{-\alpha} + (t_i + s)^{-\alpha} \right) < 0,$$

$$\pi_b' = - (1 + b_i) t_i^{-\alpha} + (1 + b_i - \beta b_j) (t_i + s)^{-\alpha} < 0.$$

As for segment π_c, we compute:

$$
\begin{aligned}
\pi_c' &= - (1 + b_i - \beta b_j) t_i^{-\alpha} + (1 + b_i) (t_i + s)^{-\alpha}, \\
\pi_c'' &= \alpha \left((1 + b_i - \beta b_j) t_i^{-\alpha-1} - (1 + b_i) (t_i + s)^{-\alpha-1} \right).
\end{aligned}
$$

If $\pi_c' = 0$, then $(1 + b_i - \beta b_j) = (1 + b_i) (t_i + s)^{-\alpha} t_i^{\alpha}$. We have then that $\pi_c'' = \alpha s (1 + b_i) (t_i + s)^{-\alpha-1} / t_i > 0$. Hence, either π_c decreases or increases with t_i on the whole range $t_i \in [t_j, t_j + s]$, or it has an interior minimum. That is, the largest value of π_c is reached either at $t_i = t_j$ or at $t_i = t_j + s$. In the former case, the whole profit function reaches its maximum at $t_i = 1$; in the latter case, it reaches its maximum at either at $t_i = 1$ or at $t_i = t_j + s$.

---

[34] As anecdotal evidence, in Belgium in October 2012, two books about the royal family were ready to be released at the same period but one of them made the choice to delay the release (the publisher gave several reasons but observers suggested that the main reason was to avoid head-to-head competition with the other book on the same topic that was released a few days before).

6.2 Proof of Lemma 2

From Lemma 1, $t_i^*(t_j) = 1$ or $t_i^*(t_j) = t_j + s$. As $t_j \geq 1 + s$, the former option brings studio i in profit segment π_a. To establish the result, we thus need to show that $\pi_a(1, t_j) > \pi_c(t_j + s, t_j)$. Developing the latter inequality, we have

$$\begin{cases} \frac{1}{1-\alpha}\left((1+s)^{1-\alpha} - 1\right) > \frac{1}{1-\alpha}\left((t_j + 2s)^{1-\alpha} - (t_j + s)^{1-\alpha}\right) & \text{for } \alpha \neq 1, \\ \ln(1+s) > \ln(t_j + 2s) - \ln(t_j + s) & \text{for } \alpha = 1. \end{cases}$$

Let $x \equiv t_j + s$, $f(x) \equiv \frac{1}{1-\alpha}\left((x+s)^{1-\alpha} - x^{1-\alpha}\right)$, and $g(x) \equiv \ln(x+s) - \ln x$ We compute that $f'(x) = (x+s)^{-\alpha} - x^{-\alpha} < 0$ and $g'(x) = -s/(x(s+x)) < 0$, which implies that the above inequality is correct and completes the proof.

6.3 Justification of $\beta_0 > 1/2$

On average, it is reported that 40% of box-office revenues are secured during the the first week of exploitation of a movie. In our setting, this observation translates into

$$\int_1^2 \tau^{-\alpha} d\tau = \frac{4}{10} \int_1^{1+s} \tau^{-\alpha} d\tau \Leftrightarrow 1 + s = \left(\frac{10}{4}\left(2^{1-\alpha} - \frac{6}{10}\right)\right)^{\frac{1}{1-\alpha}}.$$

It is also reported that a movie is eploited during 6 to 8 weeks on average. Let us thus solve the above equation for $s \in \{6, 7, 8\}$. This will give us a value of α that we can then use, with the corresponding vlaue of s, to compute β_0. The results of these computations are reported in the following table, where it is observed that the value of β_0 is larger than $1/2$ in all three instances. That allows us to conclude that the observation of 40% of revenues during the first week safely allows us to reject values of β_0 lower than $1/2$.

s	$\alpha(s)$	β_0
6	1.193	0.753
7	1.281	0.796
8	1.344	0.826

6.4 Proof of Lemma 3

We compute:

$$\pi_1^{im} - \pi_1^d = \frac{\gamma}{2\beta^2} \left(-\underbrace{\left(\beta^2\left(2\beta-1\right)+\beta_0\left(2\beta-\beta_0\right)\right)}_{+}\frac{v_1^2}{\gamma^2} - 2\beta_0\underbrace{\left(\beta-\beta_0\right)}_{+}\frac{v_1}{\gamma} + \beta_0^2 \right)$$

So, $\pi_1^{im} \geq \pi_1^d$ if the polynomial in v_1/γ in the bracket is positive. Given the signs of the different terms and given that

$$\left(\beta_0\left(\beta-\beta_0\right)\right)^2 + \left(\beta^2\left(2\beta-1\right)+\beta_0\left(2\beta-\beta_0\right)\right)\beta_0^2 = 2\beta^3\beta_0^2,$$

we have that the polynomial is positive if

$$\frac{v_1}{\gamma} \leq \frac{\beta_0\left(\beta-\beta_0\right)-\sqrt{2\beta^3\beta_0^2}}{-\left(\beta^2\left(2\beta-1\right)+\beta_0\left(2\beta-\beta_0\right)\right)} = \beta_0\frac{\beta\sqrt{2\beta}-\left(\beta-\beta_0\right)}{\beta^2\left(2\beta-1\right)+\beta_0\left(2\beta-\beta_0\right)},$$

which completes the proof.

6.5 Proof of Lemma 4

We first show that if condition (3) is met, then studio 1's best response to $b_2 = v_s/\gamma$ is $b_1 = v_1/\gamma$. We already know that $b_1 = v_1/\gamma$ is a best response locally (i.e., as long as $(1, 1+s)$ remains the ensuing equilibrium). Clearly, studio 1 cannot increase its profit by forcing the second-stage equilibrium to become $(1+s, 1)$. The only meaningful deviation is to reduce b_1 so that the second-stage equilibrium becomes $(1, 1)$. In that case, studio 1's problem is

$$\max_{b_1}\left(1 + b_1 - \beta\frac{v_s}{\gamma}\right)v_1 - \frac{\gamma}{2}b_1^2 \text{ s.t. } b_1 \leq \frac{\beta_0}{\beta}\left(1 + \frac{v_s}{\gamma}\right).$$

The optimum is $b_1 = v_1/\gamma$. Although we know that this value does not meet the constraint, let us suppose that it does for the sake of the demonstration. In this hypothetical case, studio 1's achieves the largest possible deviation profit, given by

$$\pi_1^d = \left(1 + \frac{v_1}{\gamma} - \beta\frac{v_s}{\gamma}\right)v_1 - \frac{\gamma}{2}\left(\frac{v_1}{\gamma}\right)^2.$$

Clearly, the deviation is not profitable even in this best-case scenario. We compute indeed that

$$\pi_1^{st} - \pi_1^d = \beta v_1\frac{v_s}{\gamma} > 0.$$

Consider now studio 2. As indicated in the text, a first condition for $(b_1, b_2) = (v_1/\gamma, v_s/\gamma)$ to lead to second-stage equilibrium release dates $(t_1, t_2) = (1, 1 + s)$ is condition (3), which can be rewritten as (by using $v_s = (1 - \beta_0) v_i$ and solving)

$$\frac{v_1}{\gamma} \geq \frac{\beta_0}{\beta} \left(1 + \frac{v_s}{\gamma}\right) \Leftrightarrow \frac{v_1}{\gamma} \geq \frac{\beta_0}{\beta_0^2 + \beta - \beta_0} \tag{6}$$

As shown on Figure 3, a condition for the deviation to $(1, 1 + s)$ to be feasible is $\beta_0/\beta < (\beta - \beta_0)/\beta$, which is equivalent to $\beta > \frac{1}{2}(1 + \sqrt{5})\beta_0 \simeq 0.618\beta_0$. We therefore distinguish between two cases.

(A) If $\beta_0 < \beta \leq \frac{1}{2}(1 + \sqrt{5})\beta_0$, the only possible deviation for studio 2 is to change the second-stage equilibrium to $(1, 1)$. The necessary condition for such deviation is $(1 + b_2)\beta_0 \geq \beta\frac{v_1}{\gamma}$, or $b_2 \geq \frac{\beta}{\beta_0}\frac{v_1}{\gamma} - 1$. If the ensuing equilibrium is $(1, 1)$, studio 2 would optimally choose $b_2 = v_1/\gamma$. This value meets the latter condition if and only if $\frac{v_1}{\gamma} \geq \frac{\beta}{\beta_0}\frac{v_1}{\gamma} - 1$ or $\frac{v_1}{\gamma} \leq \frac{\beta_0}{\beta - \beta_0}$, which is compatible with condition (6). In that case, firm 2's profit is

$$\pi_2^d = \left(1 + (1 - \beta)\frac{v_1}{\gamma}\right)v_1 - \frac{\gamma}{2}\left(\frac{v_1}{\gamma}\right)^2.$$

We compute then

$$\pi_2^{st} - \pi_2^d = \frac{1}{2}v_1\left((\beta_0^2 + 2(\beta - \beta_0))\frac{v_1}{\gamma} - 2\beta_0\right).$$

Hence, the deviation is not profitable if $\pi_2^{st} \geq \pi_2^d$ or

$$\frac{v_1}{\gamma} \geq \frac{2\beta_0}{\beta_0^2 + 2(\beta - \beta_0)}. \tag{7}$$

where we check that the latter fraction is smaller than $\frac{\beta_0}{\beta - \beta_0}$ and larger than the RHS in (6). It is thus a necessary condition for a subgame-perfect equilibrium with staggered release.

Suppose now that $\frac{v_1}{\gamma} > \frac{\beta_0}{\beta - \beta_0}$. Firm 2 is constrained; the best it can choose is $b_2^d = \frac{\beta}{\beta_0}\frac{v_1}{\gamma} - 1$. The deviation profit becomes

$$\pi_2^{db} = \left(1 + \left(\frac{\beta}{\beta_0}\frac{v_1}{\gamma} - 1\right) - \beta\frac{v_1}{\gamma}\right)v_1 - \frac{\gamma}{2}\left(\frac{\beta}{\beta_0}\frac{v_1}{\gamma} - 1\right)^2$$

We compute

$$\pi_2^{st} - \pi_2^{db} = \frac{1}{2}\frac{(-\gamma\beta_0 + \beta v_1 - \beta_0 v_1 + \beta_0^2 v_1)^2}{\gamma\beta_0^2} > 0,$$

36

which shows that the deviation is not profitable in this case.

(B) Consider now the case where $\frac{1}{2}(1 + \sqrt{5})\beta_0 \leq \beta \leq 2\beta_0$. Condition (7) remains necessary to make sure that studio 2 does not deviate so as to change the second-stage equilibrium to $(1, 1)$. Compared to the previous case, there is now an additional possibility of deviation, which consists in changing the second-stage equilibrium to $(1 + s, 1)$. For this deviation to be feasible, it must be the case (see Figure 3) that $v_1/\gamma < (\beta - \beta_0)/\beta_0$. But, we have just argued that condition (7) remains necessary. We now show that if (7) is satisfied, then $v_1/\gamma > (\beta - \beta_0)/\beta_0$, making the deviation to $(1 + s, 1)$ impossible. Suppose not. Then

$$\frac{\beta - \beta_0}{\beta_0} > \frac{2\beta_0}{\beta_0^2 + 2(\beta - \beta_0)},$$

which implies that

$$\beta > \frac{1}{4}\left(4 - \beta_0 + \beta_0\sqrt{\beta_0^2 + 16}\right) \equiv \hat{\beta}.$$

But that leads to a contradiction as $\hat{\beta} > 1$ for all admissible β_0 and $\beta \leq 1$ by definition.

We therefore conclude that only the deviation to $(1, 1)$ is feasible and it is not profitable if condition (7) holds, which completes the proof.

6.6 Multiproduct monopoly

To be able to compare the monopoly and duopoly situations, we continue to assume an exogenous degree of substitutability between the two movies (i.e., β).[35] Clearly, the monopolist chooses to release at least one movie at date $t = 1$ (there is indeed nothing to be gained by delaying the release of the two movies). By the same token, the studio will release the second movie no later than date $t = 1 + s$. The monopolist's problem is thus to choose b_1, b_2 and t_2 so as to maximize its total profits on the two movies:

$$\begin{aligned} \Pi^m &= \int_1^{t_2} (1 + b_1)\tau^{-\alpha}d\tau + \int_{t_2}^{1+s} (2 + (1 - \beta)(b_1 + b_2))\tau^{-\alpha}d\tau \\ &\quad + \int_{1+s}^{t_2+s} (1 + b_2)\tau^{-\alpha}d\tau - \frac{\gamma}{2}\left(b_1^2 + b_2^2\right), \\ \text{s.t. } 0 &\leq b_1, b_2 \leq 1 \text{ and } 1 \leq t_2 \leq 1 + s. \end{aligned}$$

---

[35]Arguably, a monopoly studio is also able to choose the degree of movie differentiation, insofar as it can avoid to release movies of the same genre during the same period.

Deriving profit with respect to b_1 and b_2 gives

$$
\begin{aligned}
\frac{\partial \Pi^m}{\partial b_1} &= \int_1^{t_2} \tau^{-\alpha} d\tau + (1-\beta) \int_{t_2}^{1+s} \tau^{-\alpha} d\tau - \gamma b_1 = 0 \\
&\Leftrightarrow b_1^*(t_2) = \frac{1}{\gamma} \left(\frac{t_2^{1-\alpha}-1}{1-\alpha} + (1-\beta) \frac{(1+s)^{1-\alpha}-t_2^{1-\alpha}}{1-\alpha} \right) \\
\frac{\partial \Pi^m}{\partial b_2} &= (1-\beta) \int_{t_2}^{1+s} \tau^{-\alpha} d\tau + \int_{1+s}^{t_2+s} \tau^{-\alpha} d\tau - \gamma b_2 = 0 \\
&\Leftrightarrow b_2^*(t_2) = \frac{1}{\gamma} \left(\frac{(t_2+s)^{1-\alpha}-(1+s)^{1-\alpha}}{1-\alpha} + (1-\beta) \frac{(1+s)^{1-\alpha}-t_2^{1-\alpha}}{1-\alpha} \right)
\end{aligned}
$$

Deriving profit with respect to t_2 gives

$$
\begin{aligned}
\frac{\partial \Pi^m}{\partial t_2} &= (1+b_1) t_2^{-\alpha} + (1+b_2)(t_2+s)^{-\alpha} - (2 + (1-\beta)(b_1+b_2)) t_2^{-\alpha} \\
&= \beta(b_1+b_2) t_2^{-\alpha} - (1+b_2) \left(t_2^{-\alpha} - (t_2+s)^{-\alpha} \right).
\end{aligned}
$$

Substituting $b_1^*(t_2)$ and $b_2^*(t_2)$ for b_1 and b_2, we have an expression that depends only on t_2 and on the parameters. Deriving again with respect to t_2, we can try to establish the sign of $\partial^2 \Pi^m / \partial t_2^2$. Unfortunately, we have not found any simple analytical way to do so. However, a large number of numerical simulations consistently show that $\partial^2 \Pi^m / \partial t_2^2 > 0$, suggesting that the studio's profit is convex in t_2. If so, the optimal release date for the second movie is either $t_2 = 1$ or $t_2 = 1+s$. Let us compare the two options. If $t_2 = 1$, then $b_1^*(1) = b_2^*(1) = \frac{1}{\gamma}(1-\beta) v_1$ and $\Pi^m(1) = (v_1/\gamma)(2\gamma + v_1(1-\beta)^2)$. If $t_2 = 1+s$, then $b_1^*(1+s) = \frac{1}{\gamma} v_1$, $b_2^*(1+s) = \frac{1}{\gamma} v_s$ and $\Pi^m(1+s) = (1/2\gamma)(v_1^2 + v_s^2 + 2\gamma v_1 + 2\gamma v_s)$. Then, the optimum is $t_2^* = 1$ if an only if $\Pi^m(1) \geq \Pi^m(1+s)$, which is equivalent to

$$
\frac{v_1}{\gamma} \leq \frac{2\beta_0}{2\beta(1-\beta) + 2(\beta-\beta_0) + \beta_0^2}.
$$

It can be shown that the RHS of the latter condition is larger than the RHS in Condition (2), meaning that *simultaneous release emerges for a wider configuration of parameters under a multi-movie monopoly than under a duopoly.*

6.7 Additional tables and figures

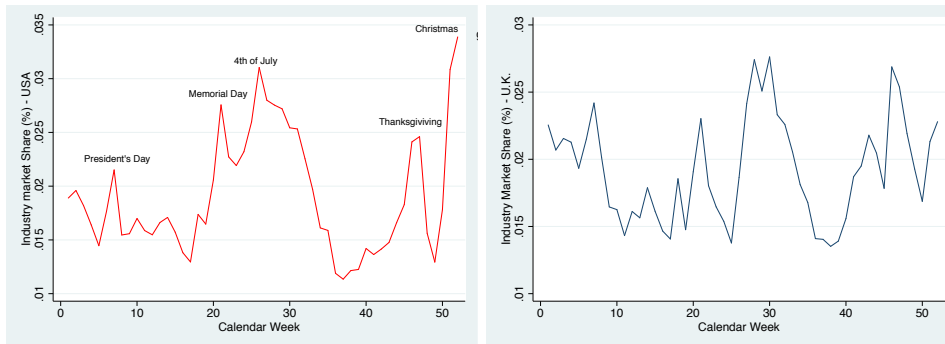|	Winter (1-8)	Spring (9-17)	Summer (18-34)	Fall (35-42)	Holiday (43-52)
Australia	1/2	15/16	26/27/28	39/40	52
France	7/8	9	28/29	42	51/52
Germany	1/2 - 5/6/7	9	20/21 - 29/30	40	51/52
Italy	1/2/3	10/11	20	37 - 42	51/52
Japan	4	16	18 - 28/29/30/31/32/33	37	50/51
New Zealand	1/2	16	26/27/28/29	40	47 - 52
South Africa	1	12/13/14/15	26/27/28/29	39/40	48/49/50/51
Spain	1 - 6/7	10	32	41	47/48/49 - 51/52
US / Canada	7	14	21 - 26/27/28	35	51/52
UK	1 - 7	14	21 - 28/29/30	42	43/44 - 46/47

Table 4: Weeks qualifying as peaks (seasonal basis)

Figure 8: Estimated seasonal peaks (left: US/Canada (left); right: UK)

	Winter (1-8)	Spring (9-17)	Summer (18-34)	Fall (35-42)	Holiday (43-52)
Australia	1/2/3/4		23 - 26/27/28/29	40	52
	1/2	15/16	26/27/28	39/40	52
France	5/6/7/8/9				43/44 - 48/49 -51/52
	7/8	9	28/29	42	51/52
Germany	1		20/21 - 29/30/31	40	46/47 - 51/52
	1/2 - 5/6/7	9	20/21 - 29/30	40	51/52
Italy	1/2/3/4/5	10			44 - 47/48 - 51/52
	1/2/3	10/11	20	37 - 42	51/52
Japan		16	18 - 27/28/29/30/31/32/33		50/51
	4	16	18 - 28/29/30/31/32/33	37	50/51
New Zealand	1/2	16	21 - 25/26/27/28/29/30		52
	1/2	16	26/27/28/29	40	47 - 52
South Africa	1	14	18 - 26/27/28/29/30	39	48 - 51
	1	12/13/14/15	26/27/28/29	39/40	48/49/50/51
Spain	1 - 4/5/6/7			41	47/48/49 - 51/52
	1 - 6/7	10	32	41	47/48/49 - 51/52
US / Canada			21 - 25/26/27/28729/30/31		47 - 51/52
	7	14	21 - 26/27/28	35	51/52
UK	7		21 - 27/28/29/30/31/32		46/47
	1 - 7	14	21 - 28/29/30	42	43/44 - 46/47

For each country, the first (second) line indicates the weeks qualified as peaks on a yearly (season) basis

Table 5: Weeks qualifying as peaks (yearly basis)

References

[1] Ainslie, A., Dreze, X., and Zufryden, F. (2005). Modeling Movie Life Cycles and Market Share. *Marketing Science* 24: 508–517.

[2] Basuroy, S., Desai, K. K., and Talukdar, D. (2006). An Empirical Investigation of Signaling in the Motion Picture Industry. *Journal of Marketing Research* 43: 287–295.

[3] Byrd, W.J. (2010). Optimal Release Timing of New Films. Chapter 2 of *The Economics of Film Distribution*, Ph.D. Dissertation, Auburn University.

[4] Cabral, L., and Natividad, G. (2013). Box-Office Demand: The Importance of Being #1. Mimeo.

[5] Calantone, R. J., Yeniyurt, S., Townsend, J. D., and Schmidt, J. B. (2010). The Effects of Competition in Short Product Life-Cycle Markets: The Case of Motion Pictures. *Journal of Product Innovation Management* 27: 349–361.

[6] Calzada, J., and Valletti T. (2012). Intertemporal Movie Distribution: Versioning When Customers Can Buy Both Versions. Marketing Science 31: 649–667.

[7] Chisholm, D., and Norman, G. (2012). Spatial Competition and Market Share: An Application to Motion Pictures. *Journal of Cultural Economics* 36: 207–225.

[8] Dalton, J.T and Leung T.C (2013). Strategic Decision-Making in Hollywood Release Gaps, Mimeo.

[9] Danaher, B. and Waldfogel, J. (2012). Reel Piracy: The Effect of Online Film Piracy on International Box Office Sales. Mimeo.

[10] Dürr, N.S., Engelstätter, B., and Wrad, M.R. (2014). Exploring Niche Competition and the Timing of Entry: The Case of the Motion Picture Industry. Mimeo.

[11] Einav, L. (2002). Essays in Industrial Organization. Ph.D. Dissertation, Department of Economics, Harvard University.

[12] Einav, L. (2007). Seasonality in the U.S. Motion Picture Industry. *Rand Journal of Economics* 38, 127–145.

[13] Einav, L. (2010). Not All Rivals Look Alike: Estimating an Equilibrium Model of the Release Date Timing Game. *Economic Inquiry* 48: 369–390.

[14] Eliashberg, J., Elberse, A., and Leenders, M.A.A.M. (2006). The Motion Picture Industry: Critical Issues in Practice, Current Research, and New Research Directions. *Marketing Science* 25, 638–661.

[15] Filson, D. (2005). Dynamic Common Agency and Investment: The Economics of Movie Distribution. *Economic Inquiry* 43, 773–784.

[16] Gutierrez-Navratil, F., Fernandez-Blanco, V., Orea, L., and Prieto-Rodriguez, J. (2012). How Do Your Rivals' Releasing Dates Affect Your Box Office? *Journal of Cultural Economics* (November).

[17] Hadida, A.L. (2009). Motion Picture Performance: A Review and Research Agenda. *International Journal of Management Reviews* 11, 297-335.

[18] Hand, C., and Judge, G. (2011). How Stable is the Seasonal Pattern in Cinema Admissions? Evidence from the UK. *Applied Economics Letters* 18, 81-85.

[19] Kendrick, B. (2014). Marvel Confirms *Captain America 3* for 2016 *Batman vs. Superman* Showdown. *Screenrant.com* (online April, 2014).

[20] Keyes, R. (2014). Marvel Studios Has Mapped Out Films All The Way To 2028. *Screenrant.com* (online April 7, 2014).

[21] Krider, R.E., and Weinberg, Ch. B. (1998). Competitive Dynamics and the Introduction of New Products: The Motion Picture Timing Game. *Journal of Marketing Research* 35, 1–15.

[22] Orbach, B.Y., and Einav, L. (2007). Uniform Prices for Differentiated Goods: The Case of the Movie-Theater Industry. *International Review of Law and Economics* 27, 129–153.

[23] Maddala, G. S. (1983). *Limited-Dependent and Qualitative Variables in Economics*, New York: Cambridge University Press.

[24] Marshall, A. (1919). *Industry and Trade: A Study of Industrial Technique and Business Organization, and of their Influences on the Conditions of Various Classes and Nations.* London: MacMillan and Co.

[25] McKenzie, J. (2012). The Economics of Movies: A Literature Survey. *Journal of Economic Surveys* 26, 42–70.

[26] Moul C.C. (2007). Measuring Word of Mouth's Impact on Theatrical Movie Admissions. *Journal of Economics & Management Strategy* 16, 859–892.

[27] Rampell, C. (2013). An Unusually Crowded Summer Box Office, in Charts. *Economix, The New York Times* (online September 5, 2013).

[28] Sakoui, A., and Palmeri, C. (2014). Studios Dodge Slugfest Opening 'Captain America' in April. *BloombergBusinessWeek* (online April 4, 2014).

[29] Thomas, A. (2004). Anatomy of a Blockbuster. *The Guardian*, June 11.

[30] Vanderhart, J. and Wiggins, S.N. (2001). Advertising, Quality, and Motion Picture Performance. Mimeo, Texas A&M University.