Strategic Promotion and Release Decisions in the Movie Market

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First version: May 2012. This version: May 2014.
VERY PRELIMINARY - PLEASE DO NOT QUOTE

Abstract

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Keywords: tbw

JEL-Classification: L13, L82

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*This research was initiated when Paul Belleflamme was visiting the Faculty of Economics of the University of Sassari, whose generosity is gratefully acknowledged.
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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 theatres). 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 looks smarter this year, 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

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\(^1\) 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
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 ??.

We discuss our results and propose some extensions in Section 5 before concluding in Section 6.
2 Related literature

The movie industry has generated a large body of research in economics and 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, Gutierrez-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 theatre, 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-

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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

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7For 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.\textsuperscript{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.\textsuperscript{9} Next, from period 1 on, they choose the release date of their movie in theatres, \(t_i, t_j \geq 1\). 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.

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:

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

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 \(N t^{-\alpha}\), where \(N\) is

\textsuperscript{8}In Section 5, we assume instead that the two movies are produced by the same studio. That allows us to compare the duopoly equilibrium with the decisions made by a multiproduct monopoly (or, equivalently, by colluding duopolists).

\textsuperscript{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).
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.\(^\text{10}\) Studio \( i \) can increase this ex ante probability by spending more on production and promotion, i.e., by raising \( b_i \).\(^\text{11}\) The ex post probability is indeed given by \( h(1 + b_i) \) when movie \( i \) is the only one on 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 \( h(1 + b_i - \beta b_j) \).\(^\text{12}\) That is, by raising its budget \((b_j)\), studio \( j \) makes it less likely that movie \( i \) will be chosen.\(^\text{13}\) 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.\(^\text{14}\)

We believe that our modelization of demand corresponds reasonably well to the reality. Our assumption of decay from the release date on mirrors the

\(^{10}\)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.

\(^{11}\)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).

\(^{12}\)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.

\(^{13}\)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.

\(^{14}\)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 \( T_t \equiv N t^{-\alpha} h (2 + (1 - \beta) (b_i + b_j)) \). When movies are perfect substitutes \((\beta = 1)\), \( T_t = 2hN t^{-\alpha} \); with \( h = 1/2 \), we have that \( T_t = N t^{-\alpha} \), 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 \((\beta = 0)\), \( T_t = hN t^{-\alpha} (2 + b_i + b_j) \); with \( h = 1/2 \) and \( b_i = b_j = 1 \) (maximum promotion), we have that \( T_t = 2N t^{-\alpha} \), meaning that all viewers watch both movies.
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

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

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.$^{15}$ Finally, we assume that studios’ objective is to maximize box-office revenues.$^{16}$ We can now express the flow of profits for studio $i$ as a function of the promotional efforts and

$^{15}$We can consider that discounting is already included in the decaying interest for movies over time.

$^{16}$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 a reasonable approximation for the objective function of distributors.” Moreover, studios incur production and marketing costs before release.
release dates chosen by the two studios:

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

In segments \(\pi_a\) and \(\pi_d\), studio \(i\) enjoys exclusivity, either because it releases its movie sufficiently before (\(\pi_a\)) or sufficiently after (\(\pi_d\)) studio \(j\); note that segment \(\pi_a\) only appears if \(t_j > 1 + s\). In segments \(\pi_b\) and \(\pi_c\), the exploitation periods of the two movies overlap, with movie \(i\) being released either before (\(\pi_b\)) or after (\(\pi_c\)) 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 response to \(t_j \geq 1\) is either \(t_i^* (t_j) = 1\) or \(t_i^* (t_j) = t_j + s\).

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 \(\pi_a\), \(\pi_b\), and \(\pi_d\) decrease with \(t_i\), while segment \(\pi_c\) 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 response 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; moreover, 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 \( (t_1^* = 1 \text{ and } t_2^* = 1 + s, \text{ or } t_1^* = 1 + s \text{ and } t_2^* = 1) \). To establish the conditions under which one or the other configuration emerges at equilibrium, we introduce the following pieces of notation:

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

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 \( \alpha \): as demands decays faster, the cumulated audience decreases. Also, the ratio \( v_s/v_1 \) decreases with \( \alpha \).

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

\[
\int_1^{1+s} (1 + b_i - \beta b_j) \tau^{-\alpha} d\tau \geq \int_{1+s}^{1+2s} (1 + b_i) \tau^{-\alpha} d\tau \Leftrightarrow \quad (1 + b_i - \beta b_j) v_1 \geq (1 + b_i) v_s \Leftrightarrow \quad (1 + b_i) \beta_0 \geq \beta b_j,
\]
where $\beta_0 \equiv 1 - v_s/v_1$. It is easy to see that the latter inequality is always satisfied if $\beta \leq \beta_0$. 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.

**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 $(t^*_1 (b_1, b_2), t^*_2 (b_1, b_2)) \in$

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

3. For $\beta > 2\beta_0$, we have $(t^*_1 (b_1, b_2), t^*_2 (b_1, b_2)) \in$

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

(Insert Figures 1 to 3 about here.)

We see from Proposition 1 and Figure 1 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 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.

---

\(^{17}\)The RHS is an increasing function of $\beta$, 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.

\(^{18}\)Krider and Weinberg (1998) reach a similar result using a slightly different timing game.
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.

3.3 Budgeting decision

Our goal is now to analyze how the 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 7.3 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 1 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 \(v_1/\gamma\) but this value does not satisfy the constraint that must be met to be in the \((1, 1 + s)\) zone.\(^{19}\) So, 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 \(\pi_1^{im}\) and \(\pi_1^d\) 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

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

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

\(^{19}\)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 \(v_1/\gamma < 1\).
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:

\[
\pi_{st_1} = \left(1 + \frac{v_1}{\gamma}\right) v_1 - \frac{\gamma}{2} \left(\frac{v_1}{\gamma}\right)^2,
\]
\[
\pi_{st_2} = \left(1 + \frac{v_s}{\gamma}\right) v_s - \frac{\gamma}{2} \left(\frac{v_s}{\gamma}\right)^2.
\]

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

\[
\frac{v_1}{\gamma} \geq \frac{\beta_0}{\beta} \left(1 + \frac{v_s}{\gamma}\right).
\]  

(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 \( t_2 = 1 + s \) (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 \((b_i^*, b_j^*; t_i^*, t_j^*) = (v_1/\gamma, v_s/\gamma; 1, 1 + s)\), involving staggered release, if and only if

\[
\frac{v_1}{\gamma} \geq \frac{2\beta_0}{\beta_0^2 + 2(\beta - \beta_0)}.
\]  

(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 $\gamma$ 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 $\beta_0 < (\beta_0/2)(4 - \beta_0)$; that is, staggered release can only emerge if demand does not decay too fast and if movies are similar enough. Moreover, one also observes that the RHS of condition (4) decreases with $\beta$ and increases with $\beta_0$, 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 $v_1/\gamma$ and release their movie immediately. (2) If $\beta_0 < 2 - \sqrt{2} \simeq 0.586$ (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 does not decay too fast and if movies are similar enough. Moreover, one also observes that the RHS of condition (4) decreases with $\beta$ and increases with $\beta_0$, which reinforces the previous findings.

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 $v_1/\gamma$: that is, values of $v_1/\gamma$ 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.

(Insert Figure 4 about here.)
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: if movies belong the same genre (strong substitutability), they are more likely to be released at different dates and with different budgets; conversely, if movies belong to different genres (weak substitutability), they are more likely to be released near the peak and with similar budgets. Hence, we can derive the following two hypotheses:

(H2a) *For a given genre of movies, the distribution of budgets is more dispersed in weeks closer to a demand peak.*

(H2b) *The distribution of movie genres is more dispersed 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.

(Say somewhere that our ambition is limited)

4.1 Data

The data (collected on the website *Box Office Mojo*) refers to American movies released in ten countries\(^{20}\) 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).

\(^{20}\) Australia, France, Germany, Italy, Japan, New Zealand, South Africa, Spain, USA/Canada, and United Kingdom.
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.”\textsuperscript{21} 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.\textsuperscript{22}

Second, to form sub-samples of relatively comparable sizes, we have grouped movies in five main “genres”, namely Drama (corresponding to the Mojo category ‘Drama’), Action (merging the Mojo categories ‘Action’, ‘Adventure’, and ‘Western’), Suspense (merging the Mojo categories ‘Thriller/Suspense’ and ‘Horror’), Comedy (merging the Mojo categories ‘Comedy’, ‘Romantic Comedy’, ‘Black Comedy’ and ‘Cartoons’), and Other (merging the Mojo categories ‘Musical’, ‘Documentary’, and ‘Concert/Performance’).

Tables 2 and 3 provide some descriptive statistics of the major variables. In Table 2, 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 genres, we observe that movies in the Action category present the highest mean and standard deviation for the production budgets. We also observe 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).

\textsuperscript{21}See www.boxofficemojo.com/about/boxoffice.htm.\textsuperscript{22}See http://en.wikipedia.org/wiki/Film_promotion or http://entertainment.howstuffworks.com/movie-cost1.htm.

(Insert Tables 2 and 3 about here.)
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 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).

(Insert Figure 5 about here.)

4.2 Empirical strategy

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 values) between the release date of a movie and the closest demand peak:

$$t_{ik} = \min |\text{peakweek}_k - \text{releaseweek}_{i,k}|,$$

where $i$ identifies the movie and $k$ the country.

4.2.1 Seasonal peaks

To identify the seasonal peaks in the demand for movies in the various countries, we follow the methodology proposed by Einav (2007). First, following Mojo, we consider five seasons: Winter, Spring, Summer, Fall, and the Holiday Season. Second, we use the weekly box office revenue data in

\footnote{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}
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.
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
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.\textsuperscript{24} Second, by
summing box-office revenues for a particular week over 13 years (or less, de-
pending on data availability), we reduce (if not eliminate) any endogeneity
problem that may exist. In Table 4, we summarize the number of peaks (by
season) and the data availability.

\textit{(Insert Table 4 about here.)}

Interestingly, we find the same pattern of movie sales as Einav (2007)
for US/Canada, and as Handa and Judge (2011) for UK data (see Figure 5
and 6). The pattern of movie sales of the other countries are shown in the
Appendix XXX.

\textit{(Insert Figures 6 and 7 about here.)}

\textsuperscript{24}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. Handa and Judge (2011) find the same evidence for the UK
market, using monthly cinema admissions data.
4.2.2 Test of hypothesis (H1)

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

\[ t_{ik} = \alpha_k + T_{ik} + \beta_1 \text{budget}_i + \beta_2 n_{ik} + \beta_3 m_{ik} + \beta_4 \text{sequel}_i + \beta_5 X_{i,k} + \varepsilon_{ik}, \quad (5) \]

where the indices \( i \) and \( k \) refer, respectively, to movies \((i = 1 \ldots 1564)\) and countries \((k = 1 \ldots 10)\), \( \alpha_k \) is a country fixed effect, \( \text{budget}_i \) is the production budget of film \( i \), \( T_{ik} \) is a dummy for the year of release in country \( k \), \( n_{ik} \) (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 same week as movie \( i \) in country \( k \), \( \text{sequel}_i \) 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).

Recalling that a decrease in \( t_{ik} \) means that the release date moves closer to the nearest peak, our theoretical predictions lead us to expect a negative value for \( \beta_1 \) (a higher budget is used as a commitment to release near a demand peak, implying a lower \( t_{ik} \)), and positive values for \( \beta_2 \) and \( \beta_3 \) (an increase in the total budgets of contemporaneous movies is taken as a proxy for an increase in the competitive pressure, which should lead the studio to release the movie away from the peak, i.e., to a larger \( t_{ik} \)).

Recalling that a decrease in \( t_{ik} \) means that the release date moves closer to the nearest peak, our theoretical predictions lead us to expect a negative value for \( \beta_1 \) (a higher budget is used as a commitment to release near a demand peak, implying a lower \( t_{ik} \)), and that \( n_{ik} \) and \( m_{ik} \) are significant variables (an increase in the total budgets of contemporaneous movies is taken as a proxy for an increase in the competitive pressure in the week, which should lead the studio to release the movie in different week. We expect that \( \beta_2 > \beta_3 \), because the pressure of the movies of the movies of the same genre is higher).

4.2.3 Test of hypotheses (H2a) and (H2b)

Moreover, we can check the dispersion around the peak. We expect to observe a higher dispersion (standard deviation) near the peak. To this scope, we calculate the standard deviation of the production budgets for each week and country over the 12 years, and, then, we calculate the weekly average of
the standard deviation. The figure XX plots release dates (horizontal axis) against the mean of the standard deviation production budget (vertical axis) for US/Canada. We observe that standard deviation is higher close to the peak, like our theoretical model predicts.

We now want to test in deep, the strategical choice of the promotion budget of a movie....TBC

PAUL:
-dans le dossier 'Figures & Tables' en dropbox, tu as la Standard Deviation pour US/Canada. J’ai calculé aussi pour UK (assur sur dropbox), meme resultat. Higher near the peak:

- je ne sais pas si j’ai bien expliqué. J’ai calculé le SD for week-year and country. Et après j’ai fait la moyenne per week. Pour avoir un seul valeur de SD.

4.3 Results

In Table 4 we present the results of our estimation. Results confirm our theoretical model. A film increases its production budget will move closer to the seasonal pick. The effect is statistical significant at 1% level. A two standard deviation increase in the budget will move the film approximately one week closer to the seasonal peak, everything else equal.

Furthermore, we find that an increase in weekly budgets of competing films will push the studio to change the release date. In particular, we find a negative value of $\beta_2$ and $\beta_3$, with $\beta_2 > \beta_3$. This holds true whether we are looking only at films of the same genre or all films of different genre. The effect is of different magnitude, with aggregate budgets of films in the same genre exhibiting a stronger effect on the release date with respect to all other firms. A t-test conducted between the two variables confirms that the difference is statistically different (we find that $Pr(T|t) = 0.000$). This result same counterintuitive, because we find find the movie will release closer the seasonal peak. We find this result because we control competition in each week (and not only in the peak). If there is more competition in a week, the firm will try to move away from this week. Clearly, it could move or closer to the peak (where the seasonal demand is more important) or away from the peak (where the demand is lower). The firm would move clearly closer to the peak.

Interestingly:
- we find that the only genre 'suspence' and 'drama' have an impact on the release date;
- we find that the sequel dummy is not significant. This comes from the fact, ??????, that sequels have an intrinsic demand....TBC
JE NE SUIS PAS SUR...

(Insert Table 5 about here.)

As a robustness check we propose 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. In Table 6, we present the results of this estimation. Results are very similar to those shown in Table 5.

(Insert Table 6 about here.)

This regression confirms that the previous results are, so, robust.

5 Discussion and extensions

We discuss here a number of extensions (tbw).

5.1 Multiproduct monopoly (or collusion)

It is not uncommon that the same movie studio releases more than one movie during a given season. (Give some empirical evidence.) Clearly, in such a situation, the studio will coordinate the budget and release decisions for these movies.\footnote{A similar coordination would take place if different studios managed to collude (which, however, we have no evidence of).} We need thus to assess how this possibility affects our analysis. First, from a theory viewpoint, we analyze the promotion and release decisions of a monopoly studio that produces and distributes two movie, and compare the results to the ones that we obtained in the duopoly...
model of Section 3. In Appendix 7.6, we show that staggered release is less likely to occur in the monopoly than in the duopoly case; in particular, for given values of the other parameters, staggered release emerges for larger values of \( \beta \) (i.e., for more substitutable movies) in the monopoly than in the duopoly case.

Second, from an empirical viewpoint, we account for same-studio movies in our empirical estimations. We consider whether there is a different effect from competition within the same studio than between studios. However, t-test confirmed that we can not reject the hypothesis of identical coefficients and therefore applied the above regressions.

5.2 Genres

- Potential weakness of our empirical analysis: separation into genres may be arbitrary.

- See Ellwood, G. (2014). Jeffrey Katzenberg on Dragon Sequels and How Marvel is DreamWorks New Competition. *HitFix.com* (online May 21, 2014). “Marketability, on the other hand, is now being hampered by other four quadrant films which are stealing audiences from animated films in the US In particular; Marvel Studios releases like "Captain America: The Winter Soldier" and "Thor: The Dark World" are the sort of movies now crossing over into "family flicks." Katzenberg says, "They are not for the 3-, 4-, 5-, 6-years-olds, but 'Captain America' was a PG-13 movie and we’re competing for 4/5 the same audience. That didn’t exist several years ago.” He continues, "This competition for it has just caught up with us now. We were in our sort of walled garden. Protected. We competed against other animation. Four or five other animated films a year and the audience was more than happy to see every one of them. In fact, they wanted more of them.””

5.3 International differences

- Dominance of US blockbusters on all markets but also, ‘national champions’. Question: do we treat correctly them correctly.

- Interesting quote: La Chine repousse la sortie du dernier James Bond en raison de son succès (Le Monde.fr Medias, 14/11/2012) “Les spec-
tateurs chinois devront encore patienter pour voir le dernier James Bond. La sortie du film, initialement prévue le 2 novembre, a été repoussée à la fin du mois de janvier 2013, pour ne pas faire d’ombre à deux films chinois à gros budgets.

- Also, peaks happen in different periods in different countries (not the same holidays, same weather conditions, etc). We have taken care of that in the empirical analysis but we need to make it clear.

5.4 Application to other information goods

- For instance, books.

- Anecdotal evidence: Belgium, 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). As an evidence of this motivation, here is a quote of the publisher of the delayed book (la Renaissance du Livre): “The two books are presented side by side on bookshop shelves. Its a prejudice for us as consumers will choose one or the other book, but not both.” (see LeVif/L’Express, October 26, 2012. Original quotation in French: “Les deux livres se retrouvent side by side sur les étals des libraires, déplore-t-on à la Renaissance du livre (l’éditeur). C’est un préjudice pour nous car les clients choisiront l’un des deux bouquins, pas les deux”.)

6 Conclusion

tbw

7 Appendix

7.1 Proof of Lemma 1

We show that the segments $\pi_a$, $\pi_b$, and $\pi_d$ decrease with $t_i$, while segment $\pi_c$ reaches its largest value at one of the extremities of the zone where it is
Let \( x \) be defined (i.e., at either \( t_i = t_j \) or \( t_i = t_j + s \)).

That is, the largest value of \( \pi \) is \( 0 \), which implies that the above inequality is correct and completes the proof.

We compute that

\[
\pi' = (1 + b_i) (t_i - \alpha) + (1 + b_i - \beta b_j) (t_i + s) - \alpha < 0.
\]

As for segment \( \pi_c \), we compute:

\[
\pi'_c = -(1 + b_i - \beta b_j) t_i - \alpha + (1 + b_i) (t_i + s) - \alpha,
\]

\[
\pi''_c = \alpha \left( (1 + b_i - \beta b_j) t_i - \alpha - 1 - (1 + b_i) (t_i + s) - \alpha - 1 \right).
\]

If \( \pi'_c = 0 \), then \((1 + b_i - \beta b_j) = (1 + b_i) (t_i + s) - \alpha \). We have then that \( \pi''_c = \alpha s (1 + b_i) (t_i + s)^{-\alpha - 1} / t_i > 0 \). Hence, either \( \pi_c \) 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 \( \pi_c \) 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 \( t_i = 1 \) or at \( t_i = t_j + s \).

### 7.2 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 \( \pi_a \). 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

\[
\begin{align*}
\frac{1}{\Gamma(\alpha)} \left( (1 + s)^{1 - \alpha} - 1 \right) > \frac{1}{\Gamma(\alpha)} \left( (t_j + 2s)^{1 - \alpha} - (t_j + s)^{1 - \alpha} \right) & \text{ for } \alpha \neq 1, \\
\ln (1 + s) > \ln (t_j + 2s) - \ln (t_j + s) & \text{ for } \alpha = 1.
\end{align*}
\]

Let \( x \equiv t_j + s, f (x) \equiv \frac{1}{\Gamma(\alpha)} \left( (x + s)^{1 - \alpha} - x^{1 - \alpha} \right) \), 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.

### 7.3 Justification of \( \beta_0 > 1/2 \)

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

\[
\int_1^{1 + 2} \tau^{-\alpha} d\tau = \frac{4}{10} \int_1^{1 + s} \tau^{-\alpha} d\tau \Leftrightarrow 1 + s = (\frac{10}{4} (2^{1 - \alpha} - \frac{6}{10}))^{\frac{1}{\alpha}}.
\]
It is also reported that a movie is exploited 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 \( \alpha \) that we can then use, with the corresponding value of \( s \), to compute \( \beta_0 \). The results of these computations are reported in the following table, where it is observed that the value of \( \beta_0 \) 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 \( \beta_0 \) lower than 1/2.

<table>
<thead>
<tr>
<th>( s )</th>
<th>( \alpha(s) )</th>
<th>( \beta_0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1.193</td>
<td>0.753</td>
</tr>
<tr>
<td>7</td>
<td>1.281</td>
<td>0.796</td>
</tr>
<tr>
<td>8</td>
<td>1.344</td>
<td>0.826</td>
</tr>
</tbody>
</table>

### 7.4 Proof of Lemma 3

We compute:

\[
\pi_{1m}^d - \pi_1^d = \frac{\gamma}{2\beta^2} \left( -\left( \beta^2 (2\beta - 1) + \beta_0 (2\beta - \beta_0) \right) \frac{v_1^2}{\gamma^2} - 2\beta_0 (\beta - \beta_0) \frac{v_1}{\gamma} + \beta_0^2 \right)
\]

So, \( \pi_{1m}^d \geq \pi_1^d \) if the polynomial in \( v_1/\gamma \) in the bracket is positive. Given the signs of the different terms and given that

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

we have that the polynomial is positive if

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

which completes the proof.

### 7.5 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

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

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

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

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 \(v_s = (1 - \beta_0) v_1\) and solving)

\[
\frac{v_1}{\gamma} \geq \frac{\beta_0}{\beta} \left(1 + \frac{v_s}{\gamma}\right) \iff \frac{v_1}{\gamma} \geq \frac{\beta_0}{\beta^2 + \beta - \beta_0}.
\]

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 \(\beta > \frac{1}{2}(1 + \sqrt{5})\beta_0 \approx 0.618\beta_0\). 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 \(b_2 \geq \frac{\beta_0}{\beta_0} \frac{v_1}{\gamma} - 1\). 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 \(\frac{v_1}{\gamma} \geq \frac{\beta_0}{\beta_0} \frac{v_1}{\gamma} - 1\) 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 \( \pi_{st}^2 \geq \pi_{d}^2 \) or

\[
\frac{v_1}{\gamma} \geq \frac{2\beta_0}{\beta_0^2 + 2(\beta - \beta_0)}.
\]

(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 \( b_2^d = \frac{v_1}{\beta_0} - 1 \). The deviation profit becomes

\[
\pi_{2}^{dB} = \left(1 + \left(\frac{\beta}{\beta_0} \frac{v_1}{\gamma} - 1\right)\right) v_1 - \gamma \left(\frac{\beta}{\beta_0} \frac{v_1}{\gamma} - 1\right)^2
\]

We compute

\[
\pi_{st}^2 - \pi_{2}^{dB} = \frac{1}{2} \left(-\gamma \beta_0 + \beta v_1 - \beta_0 v_1 + \beta_0^2 v_1\right)^2
\]

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 \( \frac{v_1}{\gamma} < (\beta - \beta_0) / \beta_0 \). But, we have just argued that condition (7) remains necessary. We now show that if (7) is satisfied, then \( \frac{v_1}{\gamma} > (\beta - \beta_0) / \beta_0 \), making the deviation to \((1 + s, 1)\) impossible. Suppose not. Then

\[
\frac{\beta - \beta_0}{\beta_0} \geq \frac{2\beta_0}{\beta_0^2 + 2(\beta - \beta_0)},
\]

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 \( \beta_0 \) 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.
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., $\beta^{26}$). 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:

$$
\Pi^m = \int_{1}^{t_2} (1 + b_1) \tau^{-\alpha} d\tau + \int_{t_2}^{1+s} (2 + (1 - \beta)(b_1 + b_2)) \tau^{-\alpha} d\tau \\
+ \int_{1+s}^{t_2+s} (1 + b_2) \tau^{-\alpha} d\tau - \frac{\gamma}{2}(b_1^2 + b_2^2),
$$

s.t. $0 \leq b_1, b_2 \leq 1$ and $1 \leq t_2 \leq 1 + s$.

Deriving profit with respect to $b_1$ and $b_2$ gives

$$
\frac{\partial \Pi^m}{\partial b_1} = \int_{1}^{t_2} \tau^{-\alpha} d\tau + (1 - \beta) \int_{t_2}^{1+s} \tau^{-\alpha} d\tau - \gamma b_1 = 0
$$

$$
\Leftrightarrow b_1^* (t_2) = \frac{1}{2} \left( \frac{1^{1-\alpha} - 1}{1-\alpha} + (1 - \beta) \frac{(1+s)^{1-\alpha} - t_2^{1-\alpha}}{1-\alpha} \right)
$$

$$
\frac{\partial \Pi^m}{\partial b_2} = (1 - \beta) \int_{t_2}^{1+s} \tau^{-\alpha} d\tau + \int_{1+s}^{t_2+s} \tau^{-\alpha} d\tau - \gamma b_2 = 0
$$

$$
\Leftrightarrow b_2^* (t_2) = \frac{1}{2} \left( \frac{(t_2+s)^{1-\alpha} - (1+s)^{1-\alpha}}{1-\alpha} + (1 - \beta) \frac{(1+s)^{1-\alpha} - t_2^{1-\alpha}}{1-\alpha} \right)
$$

Deriving profit with respect to $t_2$ gives

$$
\frac{\partial \Pi^m}{\partial t_2} = (1 + b_1) t_2^{-\alpha} + (1 + b_2)(t_2 + s)^{-\alpha} - (2 + (1 - \beta)(b_1 + b_2)) t_2^{-\alpha}
$$

$$
= \beta (b_1 + b_2) t_2^{-\alpha} - (1 + b_2)(t_2^{-\alpha} - (t_2 + s)^{-\alpha}).
$$

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 $\frac{\partial^2 \Pi^m}{\partial t_2^2}$. Unfortunately, we have not found any simple analytical way to do so. However, a large number of numerical simulations consistently show that $\frac{\partial^2 \Pi^m}{\partial t_2^2} > 0$, 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 immediate release emerges for a wider configuration of parameters under a multiproduct monopoly than under a duopoly.

References


