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# International diffusion and intellectual property rights: An empirical analysis

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## Abstract

Does a stronger intellectual property rights regime lead to the faster diffusion of new products and technology? While there is a presumption that this is the case, our analysis of data on the international release patterns of Hollywood movies suggests a more complex story: although moderate standards of IPR encourage the spread of movies, either very weak or very strong property rights tend to slow the speed with which American movies are released abroad. This empirical finding is robust to a wide variety of specifications. Overall, it appears that while some recognition of IPR may encourage diffusion, very strong IPR may actually retard the speed of diffusion.

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The increasing dependence of firms on copyrights, trademarks and patents to protect their goods and services in the international marketplace has elevated the protection of intellectual property to the center of international economic diplomacy. While efforts have sought to strengthen protections through both multilateral initiatives (WTO's TRIPS agreement) and bilateral pressures (NAFTA, Special 301 of the Trade Act), the complexity of intellectual property rights (IPR) along with the redistributive implications of reform

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means that there is no clear-cut first best solution that countries can work towards.<sup>1</sup> Consequently, there has been much debate over how the global system of IPR should be structured.

In these debates, proponents of reform have claimed that stronger IPR, while likely to involve a static cost, will generate the dynamic benefit of an increased rate of innovation. However, new results have emerged that cast doubt on the ability of stronger IPR to increase the rate of innovation (Helpman, 1993; Branstetter and Sakakibara, 2001). Yet, an increased rate of innovation is not the only benefit that has been suggested. It has become increasingly common to assume that the speed with which innovations diffuse to a country is also likely to increase in response to stronger IPR (World Bank, 2001; UNDP, 2001). While this conjecture seems relatively intuitive, existing theoretical work suggests that the relationship between market power (one aspect of IPR) and diffusion may not be so simple (see Reinganum, 1981; Quirnbach, 1986). Given almost every country receives the best part of its technology from abroad (Keller, 2001), determining whether stronger IPR leads to faster diffusion is potentially very important.

However, no empirical study has tried to assess the relative importance of IPR for the international diffusion of new goods and services, resulting in a lack of empirical evidence to guide this aspect of the debate. It is the goal of this paper to provide evidence on this issue.<sup>2</sup> To gain insight into the association between IPR and diffusion, the behavior of the major Hollywood studios is studied with a focus on how they exploit IPR in their global operations. Hollywood offers an especially attractive setting in which to study this association. In particular, it is an industry where there are no technological barriers to the international diffusion of new goods/services (i.e. Hollywood movies). This provides an environment where diffusion, in principle, could be instantaneous, and so supplies an ideal benchmark against which to measure observed behavior. In fact, the international diffusion of movies is surprisingly slow, with the average lag being around 3 months.<sup>3</sup> Given the size of this lag, when no appreciable lag was expected, one aim of this paper is to explore why it exists, and try to determine the role, if any, of IPR.

One would expect IPR to be important in the decision making process of Hollywood studios.<sup>4</sup> Given the high upfront costs and the relatively low cost of duplication, the success of Hollywood relies heavily on the ability to protect its intellectual property both within the US and in foreign markets. Indeed, foreign markets now account for a greater share of revenue than the domestic US market, a situation that has contributed to the audio–visual sector being ranked as the second largest exporter for the US.<sup>5</sup> The global success enjoyed by Hollywood also means it is often cast in the role of villain in debates

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<sup>1</sup> For an indication of the redistributive implications, see [McCalman \(2001\)](#).

<sup>2</sup> For evidence on the relationship between IPR and FDI that uses data from Hollywood, see [McCalman \(2004\)](#).

<sup>3</sup> To provide a context, the typical Hollywood movie is simultaneously released in all major cities within the US.

<sup>4</sup> The annual submission from the Motion Picture Association to the USTR is almost exclusively concerned with the documentation of the sources and degree of piracy in foreign markets. See for example [Motion Picture Association \(1998\)](#).

<sup>5</sup> This is a claim that is routinely made, see for instance the discussion of Peter Sutherland (Director General of the GATT at the time) in relation to the Uruguay Round negotiations ([Sutherland, 1993](#)). For an attempt to establish the validity of the claim see [Acheson and Maule \(1999\)](#).

over IPR standards, a dominant player seeking to further drive home its advantage by insisting that countries raise their standards of protection. This tension mirrors the pattern of IPR negotiations in general, and so provides a valuable and accessible template for exploring the implications of IPR reform.

The variation in the standards of IPR around the world offers one potential way of examining the association between IPR and the speed of diffusion. To exploit this potential, I construct a data set that covers 60 Hollywood movies and their subsequent diffusion to 37 foreign countries. Examination of this data set reveals a non-monotonic relationship between the speed of diffusion and the standards of IPR. Increasing IPR standards from a relatively low level to an intermediate level is estimated to increase the speed of diffusion. However, increasing IPR standards from an intermediate level to a high level is estimated to decrease the speed of diffusion. Such a non-monotonic relationship has important implications for the size of reform a country maybe willing to undertake, especially since one apparent benefit of IPR reform is that it contributes to faster diffusion of new products and technologies. These results suggest that such conjectures should not be accepted unquestioningly, and in fact may need to be heavily qualified.

In order to demonstrate these results, the paper is organized as follows. Section 1 describes the institutional details surrounding the selection of international release dates for Hollywood movies, a process which is determined by information transmission (spillovers/advertising/word of mouth), piracy and the short product lifecycle of movies. This information is then formalized in a model of the international release decision which produces a non-monotonic interplay between IPR and the release lag. In particular, while stronger IPR initially reduces the lag, further increases in the strength of IPR lead to increases in the length of the lag. To explore these predictions, Section 2 discusses the construction of the data set on Hollywood movies along with the hypotheses that are examined, while Section 3 presents the results and conducts sensitivity analysis.

## **1. Industry background**

With international sales estimated to be around \$US15 billion in 2002, there can be little doubt about the importance of the international market as a determinant of Hollywood's fortunes (Groves, 2003). While this total constitutes sales from all sources (theatrical, video/DVD and television), a major determinant of the whole revenue stream is how well a movie performs at the box-office. A number one hit can go on to generate revenue in a variety of ancillary markets, the value of which is typically many times greater than the revenue generated by the box-office. In contrast, a flop is quickly forgotten by the public, with little prospect of earning revenue in downstream markets. This risk is further compounded by the relatively short life cycle of films, with roughly 60% of a movies' eventual box-office generated in the first two weeks of its theatrical run (Einav, 2002). Unfortunately for movie studios, there is no simple formula for generating a number one box-office hit. Nevertheless, the money making phenomenon that is a hit movie is sufficient to lure studios to invest on average \$60 million in the production of a film, with half again invested in its promotion (MPAA 2002).

In foreign countries, theatrical success or failure at the local box-office also determines how lucrative downstream markets are likely to be. However, there is one difference between the US and foreign releases—the US release typically precedes the foreign release (i.e. a foreign country typically constitutes a downstream market). Hence, the movie is not a total unknown quantity in the foreign market. This confers the advantage that a good performance in the US can be taken as an indicator of success in other countries. Waiting to see how a film performs in the US provides an incentive to delay the release of the movie in foreign markets. This naturally begs the question of how long to wait before releasing in a foreign country? The answer to this question depends on the nature of the film.

For a typical film, the audience needs to be educated about its characteristics. Obviously, this is the same issue that is faced by distributors in the US market. The approach in the US is saturation marketing and simultaneous openings across the country, however the approach in foreign territories has another dimension.<sup>6</sup> While the release in the foreign territory can follow a centralized saturation strategy, it can also capitalize on the buzz generated by the movie's US run. By “drawing on the heat” of the US run, any formal marketing campaign is assisted by a word of mouth process that suggests a delayed release increases the potential market (Di Orio, 2002). However, delaying the release of the film also brings with it the threat that some market share will be lost to pirates (MPA, 1998; Di Orio, 2002, 2003). The decision about when to release a film in a foreign market balances these tensions, with the ultimate date picked by the distributor (either the local affiliate or the local rights holder), with this decision subject to change right to the time that the film is released (Friedman, 1992).

In the case of a sequel, where there is considerably less uncertainty about the prospects of the film, the studio will play a larger role in deciding the international release pattern, particularly in the key foreign markets. This is especially true when a “day and date” strategy is being pursued. A “day and date” release is when a film opens in the US and also in a number of international markets simultaneously. Sequels and franchise films are considered to have sufficient recognition amongst filmgoers that orchestrating an “international event” is considered to be the best option for the key markets. However, even in instances of a “day and date” strategy for some markets, it is never the case that this strategy is applied to all markets. Hence, there is always a lag between the US release and the subsequent release in some foreign markets.

### *1.1. Release date decision*

The above discussion suggests that a model of the international release decision should reflect the information transmission process (spillovers/word of mouth, advertising), the

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<sup>6</sup> In the US, two distribution strategies are followed by studios; initial wide release or platforming. Initial wide release is a nation wide roll-out of a film with up to 4000 prints of the film simultaneously showing. Platforming involves limited release (usually in New York and LA), with a broader release being an option depending on the initial performance. The predominance of wide release of studio films reflects the desire to use box-office performance as a way to establish downstream markets. All films in this study were shown in the US as part of a wide release strategy.

role of piracy as well as the short product life cycle of movies. This section presents a model that integrates all of these elements to characterize the release decision.

Assume that the target audience for a movie within a country is normalized to unity. From this target population, people become aware of/interested in seeing a movie via two sources of information. They either receive information from some centralized marketing source (e.g. advertising campaign) or they get a recommendation from an acquaintance (word of mouth). The word of mouth process operates like an epidemic model. Suppose that each existing informed film buff independently contacts a non-informed film buff with probability  $g$ . If there are  $n(t)$  buffs who are currently enthusiastic about seeing the movie, then the probability that contact will be made with a non-informed buff is given by  $n(t)g$ . In the case of an advertising campaign, it is assumed that the campaign works on  $a$  % of the uninformed at any particular point in time.<sup>7</sup> Assuming that an individual is equally likely to be influenced by either advertising or word of mouth, the rate of increase in the desire to see the film is given by the following differential equation:

$$\frac{dn}{dt} = (a + ng)(1 - n) \quad (1)$$

To find the size of an audience for a movie released in a foreign country at any date  $t$  requires solving this differential equation. The general solution yields the following equation,

$$n(t) = \frac{1 - a\omega e^{-(a+g)t}}{1 + g\omega e^{-(a+g)t}} \quad (2)$$

where  $\omega = \left(\frac{1-s}{a+gs}\right)$  and  $s$  is an initial condition. In this setting, the initial condition,  $s$ , has an important interpretation. As noted above, information spillovers about the performance of a film can play an important role in determining the foreign release date, with  $s$  capturing the size of this spillover as it represents the fraction of the population that is eager to see the film at  $t=0$  and is not driven by local marketing efforts. Eq. (2) allows for a range of interesting possibilities. Depending on the relative importance of the word of mouth channel ( $g$ ), the advertising channel ( $a$ ) or the size of the spillover ( $s$ ), this distribution function will either be S-shaped ( $g$  is relatively large) or concave (relatively large  $a$  and/or large  $s$ ).

The final aspect to be integrated into the model is piracy. Piracy is incorporated via two mechanisms. First, piracy is assumed to reduce the target audience from unity down to some smaller fraction  $\theta$ , with  $\theta$  interpreted as the strength of IPR. It is also assumed that if an individual is contacted through a word of mouth network, this network carries with it the option of access to a pirated copy of the movie. For simplicity, assume that  $(1 - \theta)$  of the individuals contacted in this way opt for the pirated version, reducing the rate of increase in potential viewers from  $g$  to  $\theta g$ . It is important to keep in mind that there are really two diffusion processes going on. One is the underlying process described above

<sup>7</sup> The type of advertising considered involves television commercials, full page newspaper and magazine advertising. These forms of advertising are the responsibility of the films distributor. Cinemas typically only promote films by posting listings of times in local newspapers.

(with a target audience of unity and a word of mouth rate  $g$ ), and then there is the process that generates moviegoers and revenue for the studios (with a target audience of  $\theta$  and a word of mouth rate  $\theta g$ ). The divergence between these two processes is determined by the strength of IPR.

Given this information diffusion process and the strength of IPR, the movie studio must decide on when to open the film. Since such weight is placed on the opening week of a film, it is assumed that the studio chooses a release date that maximizes the opening of a film, net of the costs associated with advertising the film and any cost of delaying the opening. In determining when to release a movie, a studio must decide jointly on the advertising campaign,  $a$ , and the release date,  $t$  (Reardon, 1992). The studio's problem is then:

$$\max_{a,t} p\theta \left( \frac{1 - a\omega' e^{-(a+\theta g)t}}{1 + \theta g\omega' e^{-(a+\theta g)t}} \right) - bt - ca - F$$

where  $F$  is a fixed cost of creating a marketing campaign that is geared towards the local market,  $\omega' = \left( \frac{1-s}{a+\theta gs} \right)$ ,  $p$  is price and  $b$  and  $c$  are cost parameters on time and advertising.

Given the fixed cost of designing a campaign for the local market, if the rate of piracy is sufficiently high, then the studio will not design a local advertising campaign for the release of the movie. Instead, it will rely on word of mouth and the spillover from the US market,  $s$ . In this case, an increase in IPR has two competing affects on the lag between the US release date and the local release date, a market expansion effect and a rate of diffusion effect. The market expansion effect tends to increase the time to release. Holding the rate of diffusion constant, it takes a longer time to reach a given fraction of the population. Consequently, when word of mouth is being relied upon and the audience increases, it becomes optimal to release later.<sup>8</sup> However, offsetting this market expansion effect is a rate of diffusion effect. As IPR are strengthened, fewer people opt for the pirated copy. This increases the rate at which people are willing to see the movie, which shortens the lag in the release date. While it is possible for either effect to dominate, for the large range of parameter values explored, the diffusion effect always dominated the market expansion effect. Consequently, when a studio is relying only on a word of mouth process, an increase in IPR is associated with a reduction in the time to release. The net of these two effects is illustrated in Fig. 1. Note in particular that the point of inflexion occurs sooner the stronger are the IPR.

Since designing an advertising campaign for the local market is less likely when IPR are low, this suggests that the lag should decrease as countries with low IPR increase their standards of protection. Furthermore, after countries cross a threshold level of IPR that makes an advertising campaign viable, this lag should be further reduced as an advertising campaign increases the rate of information diffusion among the target audience.

Once an advertising campaign is part of the release strategy, the relationship between IPR and the release date becomes more complicated. In particular, since IPR increases the effectiveness of the word of mouth information source (in the sense that a greater fraction

<sup>8</sup> To see this, suppose that IPR are perfect (i.e.  $\theta=1$ ) and let  $m$  denote audience size. The studio's problem (without advertising) is:  $\max_t \frac{m}{1+e^{-g-t}} - bt$ . The optimal  $t^*$  is  $\text{Log} \left[ \frac{(1-s)s(gm-2b) + \sqrt{gm(s-1)^2 s^2 (gm-4b)}}{2bs^2} \right] / g$ . It is direct to verify that the optimal release date is increasing in  $m$ .

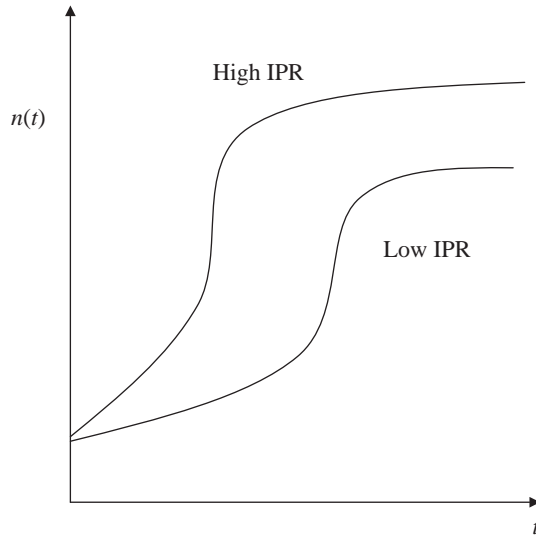


Fig. 1. No initial advertising.

opt to see the movie at a theater), this provides an opportunity for the studio to economize on the advertising effort (i.e. word of mouth and advertising are substitute sources of information). Under these conditions, the market expansion effect and the substitution effect tend to increase the lag in the release dates. In this case, for the large range of parameter values explored, increases in IPR resulted in a longer lag in the release date. This suggests that for countries with relatively high standards of IPR, further increases in

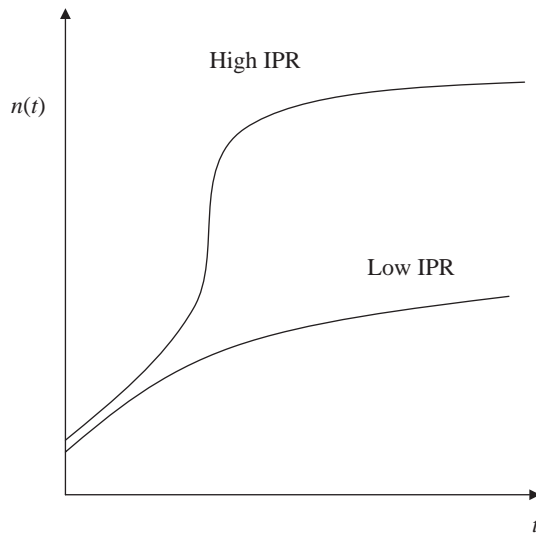


Fig. 2. Always advertise.

IPR will increase the time until release. Fig. 2 captures these effects. Note in particular that a greater reliance on the word of mouth process introduces a convex segment into the diffusion function. Consequently, higher IPR translates to a later optimal release date.

The predictions of the model developed in this section can be summarized as follows:

- i) if IPR are initially low, then increases in IPR are likely to decrease the lag;
- ii) if IPR are initially high, then increases in IPR are likely to increase the lag;
- iii) the larger is the target audience, the longer is the lag.

## 2. Hypotheses and data

The primary data source used in this analysis is the internet movie database (imdb) which contains information on the release dates of movies across countries.<sup>9</sup> The quantity of interest is the period of time between the first release of a movie within the US and its subsequent release in another country. For a given movie, a number of such periods (lags) will be generated, one for each country in which the movie is released. The unit of measure of these lags is days. Note that the focus is on the official release of a movie. The official release brings with it broad accessibility and a cinematic experience that distinguishes it from the consumption of a pirated copy which is often of low quality, in the wrong language or requires access to additional equipment to be useful (e.g. video/DVD player). Given these differences, the official and the pirated version of a movie can be considered to be different products, with the official release associated with the introduction of a higher quality product. For this reason, the release of a movie in a foreign country is seen as significant, and motivates the focus on the official release date.

The study examines the top 60 grossing American (Hollywood) movies from 1997 to 1999 within the US, and their subsequent release in 37 other countries. In total, this combination of movies and countries yields 2058 observations.<sup>10</sup> By concentrating on the top 60 movies, the analysis focuses on the set of movies that are most likely to be successful abroad, and consequently, these are also the movies one would expect to diffuse abroad the fastest. As there are no real barriers to the international distribution of movies, this setting is one where you would expect to see very fast diffusion. In this sense, focusing on the top Hollywood movies provides an ideal benchmark since there are no obvious physical reasons why these movies are not released quickly in other countries.<sup>11</sup> If there is a lag, it is likely to reflect non-technological factors.

<sup>9</sup> The website is located at [www.imdb.com](http://www.imdb.com). The majority of release dates are drawn from this source. Gaps in the data were filled from newspapers from various countries. Filling in these gaps is a very tedious process, consequently a resource constraint limited the number of countries to 37.

<sup>10</sup> Note that there is a difference between  $(60)(37)=2220$  and the 2058 observations available. This difference is mainly due to a resource constraint in data collection rather than a right hand censoring mechanism. To investigate the sensitivity of the empirical results, these missing values are set at zero, the mean and two standard deviations above the mean. All of these exercises produced results that are similar to the baseline model.

<sup>11</sup> Indeed, movies can be released very quickly in all the countries in the data set. For example, of the 37 countries in the sample, 30 have had films released “day and date” with the US. Furthermore, 35 countries have had films released within two weeks of the US opening.

Table 1 provides a list of the countries analyzed and some summary statistics for the key variables. A major point to emerge from this table is that even though the movies considered are the top Hollywood movies, on average their global distribution lags US releases by around three months. Given the technological possibility that a movie can be released anywhere in the world soon after the US release, the size of the gap between the US release and foreign release is surprisingly large. Table 2 presents the mean lag by film. This table shows the heterogeneity that exists in the foreign release pattern across films.

Table 1  
IPR and lag by country

IPR	Country	Mean lag	S.D.	Maximum
3.90	Singapore	50	40	153
3.86	Australia	60	44	162
2.86	Mexico	61	42	210
4.20	Korea, Rep.	61	63	295
2.57	Hong Kong	62	44	182
2.85	Malaysia	65	54	188
3.86	New Zealand	65	41	146
3.57	Israel	70	48	223
3.05	Brazil	72	70	420
2.45	Iceland	79	55	319
3.57	United Kingdom	81	65	399
3.19	Argentina	82	80	496
4.05	Spain	84	57	245
3.32	Ireland	85	63	381
2.24	Thailand	86	75	462
4.05	Denmark	86	49	175
3.90	Norway	87	49	182
3.86	Germany	89	56	216
4.05	France	91	54	215
4.24	Sweden	92	58	236
4.57	Austria	92	56	217
4.38	Netherlands	92	56	230
3.90	Belgium	93	55	236
3.57	South Africa	93	58	308
4.19	Finland	94	51	203
2.65	Greece	95	40	152
2.98	Portugal	97	62	283
3.91	Switzerland	102	115	883
3.19	Czech Republic	107	63	342
2.90	Poland	110	59	287
4.19	Italy	111	81	504
3.19	Slovak Republic	114	83	398
2.86	Estonia	116	61	315
3.37	Hungary	116	82	447
3.07	Chile	130	137	692
3.94	Japan	137	96	491
1.51	India	146	66	294
3.46	Average	90		
0.69	S.D.	67		

Table 2  
Lag by film

Movie	Mean	S.D.	Max	# obs.
Tomorrow Never Dies	17	26	98	35
Deep Impact	21	25	128	36
The World is Not Enough	24	21	78	37
The Prince of Egypt	26	57	224	33
Titanic	28	22	84	37
Con Air	31	35	141	34
Batman and Robin	32	23	91	34
Armageddon	37	35	164	35
Lethal Weapon 4	38	34	195	36
Wild Wild West	46	32	157	35
Men in Black	47	36	152	36
Stepmom	49	26	111	35
You've Got Mail	55	24	104	36
Antz	56	36	181	35
Enemy of the State	57	48	273	35
The Mummy	64	31	147	36
Toy Story 2	65	38	141	35
A Bug's Life	65	37	156	35
Notting Hill	66	38	147	35
As Good as It Gets	70	24	164	35
Liar Liar	72	38	189	31
Runaway Bride	73	37	140	34
Shakespeare in Love	74	20	139	35
The Lost World: Jurassic Park	76	45	152	35
The Matrix	77	36	164	36
Saving Private Ryan	80	45	259	36
The Phantom Menace	81	44	156	37
Air Force One	86	35	175	32
Godzilla	87	48	261	35
Dr. Dolittle	90	70	349	33
Face/Off	90	40	246	36
The Green Mile	93	44	315	34
Patch Adams	94	21	175	34
Contact	95	24	147	35
Stuart Little	96	59	217	33
The Spy Who Shagged Me	96	58	224	35
The Mask of Zorro	96	36	167	35
Flubber	98	89	547	37
Inspector Gadget	101	60	283	35
Sleepy Hollow	104	41	238	34
Big Daddy	108	55	358	33
Tarzan	108	64	183	35
There's Something About Mary	109	36	199	34
The Sixth Sense	112	49	238	37
The Blair Witch Project	115	50	237	32
The General's Daughter	120	31	188	33
My Best Friend's Wedding	125	38	207	32
Mulan	128	94	399	34
Good Will Hunting	133	103	462	34

Table 2 (continued)

Movie	Mean	S.D.	Max	# obs.
American Beauty	136	25	211	33
Rush Hour	138	95	504	34
The Truman Show	140	19	174	35
American Pie	142	78	358	32
Double Jeopardy	145	39	217	32
Analyze This	147	59	246	34
Hercules	155	174	883	34
George of the Jungle	175	85	491	30
The Rugrats Movie	178	71	398	30
The Waterboy	185	82	496	32
Scream 2	187	109	433	31

This pattern is broadly consistent with the discussion in Section 1, with sequels and franchise films having shorter lags than less well known films.

To examine the theoretical predictions, data on the standards of IPR and the size of the audience are employed, along with a number of other control variables. The measure of IPR is described in [Ginarte and Park \(1997\)](#) and has been extended to 1995.<sup>12,13</sup> In relation to IPR, a simple way to formulate a test of the predictions is to include a quadratic term in the model. Since the motive to decrease the lag in response to stronger IPR is likely to be most pronounced when IPR is low, the linear component should be negative. In contrast, an increase in the lag is more likely when IPR are already high, this suggests that the coefficient on the quadratic term should be positive. The final prediction examined is that the lag is increasing in the size of the audience. In this study, audience size is described by population, which is taken from the World Development Indicators. [Table 3](#) provides an overview of these measures along with a number of other control variables.

While the above variables capture motives that are clearly represented in theoretical work, a number of control variables are included (with a full list of variables and sources contained in Appendix A). The first set of control variables reflects differences in the value of the markets. Two measures are included, GDP per capita and the total box-office receipts by country. The first measure captures individual wealth while the second represents the overall importance of a particular market. The next set of controls reflects differences in tastes that are likely to influence the market for Hollywood movies. In particular, if a country is an English speaking country, then Hollywood productions do not require sub-titles or dubbing which should increase the speed of diffusion. The degree of

<sup>12</sup> I would like to thank Walter Park for making this unpublished series available.

<sup>13</sup> Unfortunately, there is not an index of copyright strength like the one that Ginarte and Park have constructed for patent protection. However, if there were such an index, it would share many of the same components, most notably enforcement measures and provisions for loss of protection (also, membership of international agreements that relate to patents, are likely to be highly correlated with membership of international agreements covering copyright). These aspects of protection cover 3 of the 5 components of the Ginarte and Park index, which suggests that patent and copyright protections are highly correlated. This claim is given some support through the high correlation of video piracy rates and the Ginarte and Park index. Using piracy rates reported by the International Intellectual Property Alliance for 1997, the correlation with the Ginarte and Park index is  $-0.76$ . This is consistent with the notion that patent and copyright protections are highly correlated.

Table 3  
Summary measures

	Mean	S.D.	Min	Max			
Population (mil)	57	161	0.28	998			
GDP per capita	18,450	12,804	450	28,433			
Country B. O. (mil)	241	345	2.20	1571			
Dom. production	54	117	1	693			
	Lag	IPR	ln(Pop)	ln(GDP p.c.)	ln(Country B. O.)	English	ln(Dom Prod)
IPR	−0.03						
ln(Pop)	0.06	−0.12					
ln(GDP p.c.)	−0.07	0.63	−0.43				
ln(Country B. O.)	−0.02	0.33	0.70	0.28			
English	−0.07	−0.06	0.07	−0.11	0.14		
ln(Dom. Prod.)	0.04	0.03	0.69	0.07	0.82	0.12	
ln(Distance)	−0.03	−0.13	0.13	−0.22	−0.05	0.38	0.15

competition that Hollywood faces in a country from domestic productions is also likely to be an important factor conditioning a studio's approach to a particular market. In addition, regional differences might be important in determining a release date (e.g. Easter is a bigger holiday in Europe than Christmas). Finally, as reflected in Table 2, film characteristics are likely to have an important influence on the release pattern of a movie. One approach to incorporating this heterogeneity is to control for the characteristics of a movie (budget, US box-office, presence of a star, critical rating, etc.). A more encompassing approach is to include film fixed effects. Results for both approaches are explored. While the inclusion of these controls seems to reflect intuitive considerations, it is not always possible to provide unambiguous motivations. For example, the number of domestic productions is also likely to reflect the degree of government support that exists within a country for cultural products, which also suggests the existence of better cultural infrastructure making the market more attractive. Hence, these variables should only be interpreted as control variables rather than having a specific theoretical interpretation. In light of this, the robustness of the results will be examined by sequentially omitting these control variables.

### 3. Results

The estimated coefficients along with the robust standard errors are reported in Table 4. The first two columns report the OLS estimates, using movie characteristics and movie fixed effects, respectively. The hypothesis that the larger the audience the longer the lag finds support under both specifications. Not only do the estimated coefficients have the correct signs, but they are also significant at the 1% level. The more nuanced predictions about the association between the speed of diffusion and IPR are also consistent with the data. In particular, the null hypothesis that the linear component is positive can be rejected at the 5% level of significance for both specifications. Similarly, the null hypothesis that the coefficient on the quadratic term is negative can be rejected at the 5% level of

Table 4  
Determinants of the lag between US release and foreign release

Est. method	OLS			Neg Bin	Weibull
	Days (1)	Days (2)	ln(days) (3)		
Dep. variable				Days (4)	Days (5)
IPR	−38.71** (18.96)	−39.33** (17.25)	−0.71*** (0.24)	−0.48** (0.20)	−0.34** (0.18)
IPR <sup>2</sup>	5.53** (2.67)	5.66** (2.41)	0.10*** (0.03)	0.07** (0.03)	0.05** (0.02)
ln(Pop)	16.54*** (4.99)	16.99*** (4.51)	0.20*** (0.07)	0.28*** (0.05)	0.30*** (0.04)
ln(GDP per cap)	10.37 (6.83)	10.26* (6.16)	0.09 (0.08)	0.19*** (0.07)	0.22*** (0.06)
ln(Country BO)	−20.37*** (5.82)	−20.97*** (5.21)	−0.24*** (0.08)	−0.33*** (0.06)	−0.36*** (0.05)
English	1.10 (4.67)	1.02 (4.11)	−0.02 (0.07)	0.03 (0.05)	0.04 (0.05)
ln(Dom Prod.)	7.70*** (2.61)	7.75*** (2.30)	0.10*** (0.04)	0.11*** (0.03)	0.12*** (0.02)
ln(dist)	3.72 (8.42)	3.48 (7.54)	−0.01 (0.12)	−0.04 (0.09)	−0.03 (0.08)
Europe	14.90** (7.15)	15.56** (6.61)	0.19 (0.12)	0.03 (0.08)	0.01 (0.07)
Latin America	1.70 (10.33)	1.67 (9.47)	−0.18 (0.14)	−0.14 (0.10)	−0.06 (0.09)
Asia Pacific	−11.62** (5.65)	−10.55** (5.41)	−0.24** (0.11)	−0.16** (0.08)	−0.09 (0.09)
ln(Budget)	−29.98*** (3.73)				
“Star”	−0.67 (3.64)				
ln(US BO)	−7.37 (4.94)				
Rating	1.65 (1.27)				
Dummies					
Movie	no	yes	yes	yes	yes
Monthly	yes	no	no	no	no
Studio	yes	no	no	no	no
Genre	yes	no	no	no	no
Log-likelihood	−	−	−	−10681.82	−2161.47
R-squared <sup>a</sup>	.268	.427	.380	.413	.399
N	2058	2058	2058	2058	2058
Turning Point	3.50	3.47	3.55	3.43	3.40

Robust standard errors in parenthesis.

<sup>a</sup> The R-squared reported for the first three columns is the usual one. For the last three columns, it is the squared correlation coefficient between days<sub>*i*</sub> and the appropriately transformed predicted value for observation *i* (following Wooldridge, 2002).

\* Statistically significant at the 10% level.

\*\* Statistically significant at the 5% level.

\*\*\* Statistically significant at the 1% level.

significance for both specifications. However, before concluding that the relationship between IPR and diffusion is non-monotonic, there are some issues that arise with the use of the OLS methodology that need to be addressed.<sup>14</sup>

The final three columns of [Table 4](#) present estimates for three different approaches to modeling the dependent variable (i.e. the lag). While the first two columns take the dependent variable as the number of days and apply least squares techniques, it might be argued that this neglects the non-negative property of the lag. A log transformation applied to the lag is a simple way to account for this attribute of the data with the resulting estimates reported in column 3.<sup>15</sup> While the interpretation of the estimated parameters is now slightly different from the previous columns, the estimates still have the predicted signs and are statistically significant. Another issue is the discrete nature of the release lag (measured in days), which along with the non-negative property of the data, suggests that a count model might be appropriate. The estimates in column 4 are for the negative binomial model. Once again the estimates are consistent with the predicted signs and are significant. Finally, given the focus on the period of time between the US release and the foreign release, the data can also be approached from a duration model perspective. The estimates in column 5 are for a Weibull specification of the hazard rate and are reported in the accelerated time to failure form to allow comparison with columns 3 and 4. As is apparent from the estimated signs and standard errors, this specification also supports the predictions from Section 1. Consequently, when viewed from a number of perspectives, the results in [Table 4](#) provide strong evidence of a non-monotonic relationship between IPR and diffusion.

Given the presence of the non-monotonicity, it is of interest to assess the relative importance of the linear and quadratic components. Since the measure of IPR ranges from 0 to 5, a natural question to ask is whether the minimum occurs within this range. For all the specifications explored, the implied turning points fall within this range and are reported in the bottom row of [Table 4](#). The turning point ranges from a low of 3.40 to a high of 3.55. This suggests that the non-monotonicity predicted by the model in Section 1 is not only a theoretical possibility but is also empirically relevant.

The results reported above have important implications. In particular, they only lend partial support to the working assumption in the policy literature that higher standards of IPR lead to faster rates of diffusion. While the results are consistent with the assumption that countries with low IPR would experience faster diffusion for incremental increases in their standards of IPR, the results do not always support this assumption for all levels of reform. Specifically, once countries have attained a moderate level of IPR protection, then

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<sup>14</sup> Note that the theoretical model developed in the previous section suggests that advertising effort will be a key determinant of the release date and therefore should be included in the estimated equation. Furthermore, advertising effort will also be determined by the level of IPR. This suggests that the coefficients on IPR and IPR<sup>2</sup> are likely to be biased due to the omission of advertising effort from the release lag equation. Given the negative relationship between advertising effort and IPR suggested by the theoretical model, this implies that the estimates reported are biased downward. In effect, this means that the coefficients on IPR and IPR<sup>2</sup> measure both the direct effect of IPR and the indirect effect due to induced changes in advertising effort. However, since the focus is ultimately on the net effect of IPR reform, this bias is not problematic in this setting.

<sup>15</sup> Since there are some zero lags, one day has been added to all the lags before the log transformation is employed.

further increases in IPR are likely to reduce the speed of diffusion. Table 5 provides some sense of magnitude by presenting results for two potential reforms, the adoption of a minimum level of IPR at the mean of the sample (IPR=3.46) or the adoption of a minimum near the maximum observed in the sample (IPR=4.5). Column 1 confirms that reforms which increase IPR to moderate levels can have a positive impact on the speed of diffusion. The results for India are the most pronounced, with its lag estimated to be reduced by about one fifth. Other countries are also estimated to record notable decreases

Table 5  
Implications of IPR reform<sup>a</sup>

	%Δ mean lag under min IPR	
	IPR=3.46	IPR=4.5
India	-17	-11
Thailand	-8	-2
Iceland	-8	1
Hong Kong	-6	4
Greece	-4	3
Malaysia	-2	7
Estonia	-3	8
Mexico	-2	4
Poland	-2	4
Portugal	-1	6
Brazil	-1	8
Chile	-1	5
Argentina	0	6
Czech Republic	0	6
Slovakia	-1	8
Ireland	0	8
Hungary	0	6
Israel	-	10
South Africa	-	8
UK	-	7
Australia	-	10
Germany	-	7
New Zealand	-	9
Belgium	-	6
Norway	-	7
Singapore	-	12
Switzerland	-	6
Japan	-	4
Denmark	-	5
France	-	6
Spain	-	6
Finland	-	4
Italy	-	4
South Korea	-	6
Sweden	-	4
Netherlands	-	2
Austria	-	-

<sup>a</sup> Derived from Table 4, column (2).

in their lags (Thailand, Iceland, Hong Kong). However, column 2 paints a less optimistic picture if the minimum level of IPR is set at a relatively high level. Under this experiment, only two countries would receive any increase in the speed of diffusion. The most prominent prediction of column 2 is that reform is estimated to increase the lag of most countries. These results suggest that the conjectures that have guided the policy literature over the relationship between IPR and the speed of diffusion should not be accepted unquestioningly, and in fact may need to be heavily qualified.

### 3.1. Sensitivity analysis

In addition to IPR and audience size, the specifications investigated in Table 4 also include a number of control variables. The signs on some of these controls seem relatively intuitive. For instance, if a film has a big budget, includes a big star, or has had a big US box-office, then Hollywood movies tend to diffuse faster under these conditions. In addition, the greater the number of local productions, the longer diffusion takes. One of the more interesting results is that while a larger local box-office significantly increases the speed of diffusion, the measure of individual wealth (GDP per capita) is not significant (and has a positive coefficient). This suggests that it is the aggregate value of a market that determines the release pattern, rather than average wealth of individuals. The regional dummies also provide some interesting information. A robust finding is that Europe tends to receive films later than other parts of the world, holding other things constant. In contrast, the Asia Pacific region tends to receive things the fastest. Such a pattern could be driven by a more pronounced difference in school and other holidays that exist between Europe and the US, than between the Asia Pacific region and the US. Table 6 gives an overall sense of the importance of the various factors in determining the release lag by reporting the standardized beta coefficients. These coefficients indicate that value of the total box-office in a country is the most important factor determining the speed of release, followed by the strength of IPR, the size of the population and the number of local movies produced.

While there is a broad motivation for including control variables, the nature of these relationships is nevertheless relatively speculative. Consequently, it is important to

Table 6  
Standardize beta coefficients<sup>a</sup>

Variable	Beta coefficient
IPR	−0.38
IPR <sup>2</sup>	0.36
ln(Pop)	0.37
ln(GDP per cap)	0.15
ln(Country BO)	−0.43
English	0.01
ln(Dom Prod.)	0.15
ln(dist)	0.02
Europe	0.11
Latin America	0.01
Asia Pacific	−0.07

<sup>a</sup> Based on estimate from Table 4 column 2.

Table 7  
Sensitivity analysis

	Co-eff. on IPR	Co-eff. on IPR2
<i>Omitted variable</i>		
Population	– 21.60*	3.09*
GDP per cap	– 27.24*	4.40*
Country B.O.	– 29.26*	4.43*
Eng. lang. dummy	– 38.61**	5.57**
Domestic production	– 54.44***	7.21***
Distance	– 38.59***	5.60***
Regional dummies	– 28.49*	5.01**
Film dummies	– 36.20*	5.23*
<i>Other IPR measures</i>		
BSA piracy rate (0–1)	99.50*	– 192.50***
<i>IV estimates</i>		
IPR65, IPR65sq	– 128.20*	20.63**

examine the key results in relation to the omission of these variables in the estimated equations. These sensitivity results are contained in Table 7. The left column lists the variables that have either been excluded or included to examine the robustness of the relationship between IPR and diffusion. The model specification presented measures the lag in days and includes film fixed effects. The first eight rows omit, in turn, the population size, GDP per capita, country box-office, domestic production, the language dummy, distance, regional dummies and the movie dummies. As is evident from the parameter estimates on IPR and IPR<sup>2</sup>, the results show little sensitivity to the omission of these more extraneous variables.

Another issue that is investigated in Table 7 is the robustness of the results to different measures of IPR. One alternative measure is the index of piracy developed by the Business Software Alliance (BSA, 2003). This measure ranges from 0 to 1, and in contrast to the Ginarte and Park index, higher values denote a greater level of piracy (or weaker IPR). In particular, note that since BSA is a measure of piracy, the predicted signs will be the opposite of those associated with IPR. The BSA measure has an observed range of 0.28 to 0.82, with a mean of 0.49.<sup>16</sup> The correlation with the Park and Ginarte index is – 0.73. Inspection the 9th row of Table 7 shows that the non-monotonic prediction is robust to this different measure of IPR.

A final issue examined is how sensitive the results are to correlation between the Ginarte and Park index and other unobserved country characteristics that might influence the speed of diffusion. This issue is similar to one that has arisen in other studies of the impact of IPR on behavior in an international context (e.g. trade flows, FDI, etc.). Following the identification strategy of Maskus and Penubarti (1995), the 10th row presents results based on lagged determinants of IPR.<sup>17</sup> In this case, the Ginarte and Park

<sup>16</sup> The BSA does not report piracy rates for either Estonia or Iceland. The estimates reported are therefore based on 1944 observations.

<sup>17</sup> Similar strategies are employed by Smith (1999) and (2001) and Yang and Maskus (2001).

measure from 1965 and its square are used as instruments.<sup>18</sup> Once again, the non-monotonicity of the relationship between the speed of diffusion and IPR is evident. Overall, the results of these sensitivity exercises (both excluding and including a range of variables) suggest that the non-monotonic relationship between IPR and diffusion is a robust finding for this data set.

#### 4. Conclusion

The reform of the global IPR system has ignited a particularly contentious debate over the advantages and disadvantages of IPR. One issue that has emerged as important is the impact of IPR on the speed of diffusion. Given almost every country receives the best part of its technology from abroad, the nature of this relationship is very important. However, no empirical study has tried to assess the relative influence of IPR on the international diffusion on new goods and services, resulting in a lack of empirical evidence to guide this aspect of the debate.

This paper is the first to provide evidence on this issue. By employing a product level data set, dates can be established for when a product is first made available and subsequently how long it takes to reach a particular country. Such disaggregated data are particularly critical in this setting. While theory does provide some guidance in thinking about the implications of IPR reform for the speed to diffusion to foreign markets, ambiguities do arise. By studying firm behavior at the product level, this paper is uniquely placed to shed light on the subtleties of the relationship between IPR and international diffusion.

In relation to these subtleties, the behavior of the major Hollywood studios is particularly interesting. Not only is Hollywood one of the major export earners for the United States, but it is also critically dependent on the protection of intellectual property rights for its success. Analysis of this industry reveals that the nuances suggested by the theoretical models are present in the data. In particular, a non-monotonic relationship between IPR and diffusion characterizes the release pattern of major Hollywood movies abroad: while moderate standards of IPR encourage the spread of movies, either weaker or stronger property rights tend to decrease the speed with which American movies are released abroad. This is a robust empirical finding that is consistent with a variety of specifications. Overall, it appears that while some IPR recognition may encourage diffusion, very strong IPR may actually retard the speed of diffusion. These results argue against any simple prediction about the implications of IPR reform for the speed of diffusion, suggesting instead that the nature and magnitude of the impact of IPR reform will depend critically on the initial standard of IPR, among other factors. Furthermore, the interplay of promotion, piracy and product lifecycles is common to many IPR dependent products (e.g. pharmaceuticals), so Hollywood's response to stronger IPR is unlikely to be too novel not to at least provide suggestive evidence more generally.

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<sup>18</sup> Since a number of former Soviet countries (Czech Republic, Estonia, Hungary, Poland, Slovak Republic) do not have IPR measures in 1965, the resulting estimates are based on 1820 observations.

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## Appendix A. Data and sources

Release Lag: days between theatrical release in US and theatrical release in specified country source: derived from [www.imdb.com](http://www.imdb.com), various newspapers  
 IPR: Ginarte and Park index for 1995. Source: Walter Park (unpublished)  
 GDP per capita, population. Source: World Development Indicators  
 Total Box-office by country. Source: *Screen Digest* (1999)  
 Domestic Film Production. Source: *Screen Digest* (1999)  
 Film Budget, US box office. Source: [www.imdb.com](http://www.imdb.com)  
 Presence of a “star”, dummy. Source: [ris.ss.uci.edu/econ/personnel/devany/web/papers/starlist.html](http://ris.ss.uci.edu/econ/personnel/devany/web/papers/starlist.html)  
 Critical rating, San Francisco Chronicle's Critical Consensus source: [www.sfgate.com/eguide/movies/criticalconsensus/](http://www.sfgate.com/eguide/movies/criticalconsensus/)  
 Genre. Source: Blockbuster Video

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