Production Technology and Long Term Trends in Movie Content: An Empirical Study

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Abstract:

Our analysis of trends in content of the Top 20 U.S. box office movies over the 1967-2008 period confirms that certain film type (or “genre”) labels such as “action,” “animation” and ‘sci-fi” have become more prevalent, while others such “drama,” “romance” and “musical” have declined. We test the hypothesis that these changes over time can be explained by advances in movie production technology, which favors the profitability of certain film types over others (eg, “action,” over “drama”) by making them relatively more attractive to audiences and/or relatively cheap to produce. In support of this hypothesis, we show that increasingly prevalent film types tend with few exceptions to be relatively “technology intensive,” as measured by the proportion of end credits in technology categories, while declining types tend to be non-technology intensive.

Keywords: Movie, motion picture, content, production technology

JEL: O33, Z11

I. Introduction

A trend in recent decades toward worldwide market dominance by Hollywood's high budget, special effects- laden science fiction, action, fantasy, and related movie types is widely acknowledged (Olson 1999; Epstein 2005). Industry critics have often associated Hollywood's modern fare with increasing violence or denigration of America's image abroad, as well as deterioration in the aesthetic quality or cultural representativeness of leading American movies (Kakutani 1997; Hirschberg 2004; McGriff 2009). On the other hand, of course, audiences worldwide enjoy these movies in great numbers. Whether economic, social, or cultural effects are positive or negative on net, the fact that U.S. produced movies account for over 80% of the world box office (Vogel, 2011) and apparently a comparable share of the DVD film market, testifies to the broad significance of movie content trends.

Among explanations advanced for these trends are the corporatization and conglomeration of Hollywood studios, and Hollywood's "globalization," or more specifically, a growing significance of the studios' foreign revenue sources (Balio 2002; Fu and Govindaraju 2010; Miller et al. 2001). As the relative importance of foreign markets rises, that is, the profit calculus of studios is said to have led them to respond by homogenizing content or selecting movie types--or to use a term more common to the industry and media scholars, "genres,"-- such as "science fiction" or "action," that more easily cross cultural barriers around the world. Discouraging to this globalization explanation, however, available data show that over a four to five decade horizon, the relative contribution of foreign markets to U.S. studio revenues has not in fact increased.[1]

[1] From a range of 29% to 33% in the 1981-85 period, the foreign proportion of Hollywood's box office revenues increased to a range of 45% to 48% in the 1990s, and 43% to 53% from 2000 to 2009 (SNL Kagan 2010; Waterman 2005). Between 1965 and 1969, however, the foreign contribution to MPAA

In this paper, we seek to document long term trends in the content of popular Hollywood films, and to suggest an alternative economic explanation of these trends: advances in production technology. There has been continuous advance in film production technologies since the industry's beginnings, including dramatic improvement in visual and special effects due to computer generated imagery (CGI) beginning in the 1970s and 1980s (Pierson 1999; Wang 2009). Our primary hypothesis is that over time, production investments have shifted toward movie types that are most amenable to special effects and related production technologies. This shift occurs because those films become relatively more attractive for audiences to watch, or because they become, other things equal, relatively cheap to produce.

First, we measure shifts in the prevalence of 20 film genre labels among the top 20 U.S. box office grossing movies over a 42 year period, 1967-2008. Using a relatively recent sample of major theatrical films, we then measure the average "technology-intensiveness" of these same 20 types based on the proportions of end credits that are accounted for by special and visual effects, and related technology functions. We test our hypothesis by comparing the correspondence between each type's growth or decline over time with its average technology intensiveness.

Beginning with a brief literature review, we set out the economic theory behind our hypothesis (Section II). We then turn to our empirical methodology and analysis in Sections III through IV, followed by discussion and conclusions in Sections V and VI.

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member box office revenues published in *Variety* ranged from 49% to 55%, roughly the level of the 2000s (Guback 1969). MPAA member companies have accounted for the overwhelming share of both domestic and foreign box office receipts since at least World War II (Wildman and Siwek,1988; Guback 1969).

II. Related Literature and Theory

A number of empirical studies have been about trends in television content categories (eg, Dominick and Pearce 1976; Einstein 2004). The film studies literature contains numerous studies of movie genres, but these are generally not statistically oriented; see especially Neale's (2000) study of the historical evolution of movie genres. Several empirical studies in the economic and marketing literatures have analyzed the effects of movie genres, among a number of other factors, on movie demand (eg,, Sochay, 1994; Desai and Basuroy, 2005). There have also been a number of studies of the motion picture ratings system and its effects on film choice and film content (eg, Austin, Nicolich & Simonet, 1981/1982; Wilson & Linz, 1990). Overall, movie content has received less empirical attention than television, and to our knowledge, trends in film content has not been systematically studied.

Throughout this paper's period of study, there have been six or seven major Hollywood studios that control about 75% to 90% of the U.S. movie box office; as implied above, these firms tend to have high market shares in foreign markets, exceeding 50% in many countries for the studios as a group (Vogel, 2011). Each year, these firms select around 150 to 200 major movies from many thousands of possible film ideas, pitches, scripts, etc, that are presented or available to them. As industry gatekeepers, they generally produce or finance the movies they select, and then distribute them to theaters, followed by video, television, and other media.

Competition among studios for film properties is clearly intense (see for example, Bart and Guber 2004), suggesting competitive behavior in the film selection process. Product selection in competitive industries has been modeled by Spence (1976), Dixit and Stiglitz (1977), and Lancaster (1975), and notably by Spence and Owen (1977) for the case of television programming. These authors provide the basis for our relatively simple framework.[2]

Over some given time interval, say one year, competing studios select the *n* most profitable film properties from a discrete but very large population of *N* project choices offered by producers. For an individual film *i* in *N*,

$$(1)\ \pi_i = E(R_i) - C_{\mathrm{i}}$$

Time discounted revenues, R_i, for any individual film project are notoriously uncertain (DeVany and Walls 1996; DeVany and Walls 1999) but as long term stability of market shares in the industry suggest, average returns are reasonably predictable when spread over a large number of films. The costs of a given film project, C_i, including production, distribution, and marketing, may also vary, but are reasonably predictable to the studio once talent and other main elements are set.

In general, films are substitutes for each other from the consumer's perspective. The product selection process continues until no additional films, or no different array of films, could be profitably selected. The end result is a potentially wide variety of *n* unique films of different expected revenues and costs.

It follows under reasonable assumptions that if the frequency distribution of expected revenues of films of a certain type *A* (say "action"), $f\ E(R_{Aj})$, $j = 1\ldots.J$, $J < N$, rises relative to other types, then *A* type movies are likely to become more prevalent among the major studios' selections. Comparably, if the production or other costs of type *A* films fall, *A* type movies will also increase in prevalence.

[2] These authors were primarily concerned with issues of underproduction or overproduction of product variety relative to a welfare optimum, and how those outcomes depend on characteristics of consumer demand and firm costs.

Of course, either costs or expected revenues for films of a given film type might rise or fall for a variety of reasons. For example, certain genres (say westerns, for example) may simply become less popular over time. Or, if certain genres are favored by foreign markets, for example, and those markets expand, the likelihood of studio selection of those types also would increase.

Changing production technology, however, can be expected to systematically affect film selection by reducing the relative costs of certain types, and/or by making those types more attractive to patrons. To illustrate, Waterman (2007) suggests two types (or components) of technological change that may affect audio visual products, such as theatrical films: "cost-reducing" and "quality-enhancing."

A "cost reducing" technology means that the same outcome can be achieved, other things equal, more cheaply. For example, a train wreck might be realistically simulated using computer generated visual effects with much less danger and thus lower cost, or a digitized crowd scene may duplicate at lower cost a crowd scene created with live extras. Consider, for example, the massive battle scenes in *Return of the King* (2003).

Although the actual average production investments into major studio feature films rose dramatically over our long period of study,[3] the influence of cost saving technology is illustrated by the reaction of one studio executive to the commercial development of CGI for animated films in the 1990s, led by the commercial success of *Toy Story* in 1995.

> "They [CGI movies] are particularly appealing to studios because they're much cheaper and quicker to produce. The rule of thumb, [Sony Pictures executive Penny Finkelman] Cox says, is that it takes 400 artists four years to bring a 2-D movie to

[3] MPAA Annual Reports, various issues; Vogel 2011.

> theaters. It takes half that number in three years for a computer-generated movie. As a result, a digital movie typically costs about $80 million, compared with $150 million for a traditional animated feature."[4]

A massive shift from 2-D to CGI animation technology occurred from the mid-1990s and to the early 2000s, but ironically, average production costs of major Hollywood animated features increased over this period much more rapidly than did other major studio films on average (from the 1992-1994 period to the 1998-2002 period, 178% for animated films vs. 84% for all MPAA-member distributed feature films except animation).[5]

Such apparently contradictory trends can be attributed to producer incentives following from the "quality-enhancing" features of CGI technology. More generally, a quality-enhancing technology creates a more appealing effect than can otherwise be achieved at the same cost. For example, CGI is a much more versatile animation technology, and in predominantly live action feature films, digitally created or enhanced monsters, volcanoes, spectacular floods, or decapitations, may have much greater impact than any live action could produce. Examples are easily brought to mind, such as the fantastic creatures and battle scenes in *Avatar* (2009). CGI technology is also commonly used to enhance the appearance of live stunts in feature films.

Most actual use of movie production technology appears to embody both cost-reducing and quality-enhancing components. In either case, it is reasonable to expect that certain film types should benefit more than others from the forward march of production technologies. For example, it may be that genres which make greater use of violence or the fantastic will benefit in

[4] Eller (2002, May 9). Sony to launch Feature Animation Unit. *Los Angeles Times.*
[5] Calculated by the authors using the A.C Neilsen Master Database.

attractiveness more than others because other things being equal, they become cheaper to make, or because they become more interesting and engaging to watch relative to other types, such as romance, which can evidently make little use of digital technology. Our more general hypothesis is thus that film genres or types which make greater use of special effects and related production technologies will become more prevalent over time.

III. Trends Over Time in U.S. Movie Genres

Method

Using *Variety* lists, supplemented by the Nielsen EDI Master Database, and www.boxofficemojo.com, we measured trends in the prevalence of 20 movie type labels among the top 20 U.S. box-office performing movies from 1967-2008. While inclusion of earlier years would be desirable, we deemed industry box office data before 1967 to be too unreliable for this purpose.[6] Also, the top 20 movies are a small fraction of the 400 to 600 theatrical features typically released each year in the United States since the 1970s, or even of the 150-200 films typically released by Motion Picture Association of America (MPAA) member studios. Available data show, however, that the top 20 movies earned an average of 45.1% of total US box office revenues from 1988-2002 (the years for which we have systematic data available), with no apparent trend over that period. These top films are also Hollywood's main entries in the domestic and world film market, and they account for the bulk of public and critical interest.

[6] Before 1967, *Variety* annual reports of top performing films were in some years based on "anticipated" rather than actual revenues.

Movie type information for this and other parts of this study were obtained from the www.imdb.com, Internet database, which covers virtually all significant theatrical feature films released in the U.S. during the period of our analysis. The *imbd.com* database makes use of 28 different "genre" labels, which are frequently assigned in multiple combinations to individual films (eg, "action/adventure/romance"). In this study, we used only the 20 of these labels for which statistical analysis of trends was possible. Seven of the omitted labels ("adult," "film noir" "game-show," "news," "reality-TV," "short," and "talk-show") did not appear at all in the top 20 lists. Trends could not be estimated for the other omitted label, "documentary," which appeared only five times in our top 20 lists.

A shortcoming of our study is that systematic information about *imdb.com*'s methods for genre categorization is not available. The various genre labels used are defined on the *imdb.com* website, but it seems evident that for *imdb*'s historical database, the labels are assembled from a variety of different sources. For older films, for example, informal sampling we conducted indicated that genre information is usually taken from film guidebooks published by the American Film Institute (1993). In the process of its becoming the dominant Internet source for film information, *imdb.com* acquired at least one other firm, *TVGen*, that offered similar information about film genres; that acquisition may have affected labeling. In spite of these limitations, the movie type information we use is apparently the dominant consumer and industry resource for content of feature films commercially released in the United States, and is the only source of movie type information over time. Also, as detailed below, we employ numerous different genre labels in our empirical analysis; we have no a priori reason to expect a labeling bias either to the advantage or disadvantage of our hypothesis.

Descriptive Results

Table 1 describes overall results of the time trend analysis for our 840 film database (42 years x 20 movies). The first column indicates that there are large differences in the total number of times each of the 20 genre labels used by *imdb.com* appeared in the top 20 lists.

[Table 1 near here]

Columns 2 through 10 of Table 1 show 5 year averages (2 years for the ending 2007-2008 period) for the % of the movies in each year's Top 20 list to which each label was assigned. Indicated by these data are a number of apparent trends. Figure 1 illustrates five year average trends (2 years for the ending 2007-08 period) for the five most frequently appearing types in the database, which together accounted for 58% of all genre label appearances. Appearances of "action," "adventure," "thriller," and "comedy" all increased, from 20% to 58%, 20% to 53%, 16% to 35%, and 33% to 53% respectively. "Drama," the most prevalent of these five genres in the 1967-71 period (appearing in 58% of cases), became the least prevalent of the five in 2007-2008 (appearing in 20% of the Top 20 movies).

[Figure 1 near here]

Regression Models

To evaluate trends statistically, we estimated a simple time trend model, using annual data, for each of the 20 genre labels in the study.

$$(2)\ Y_i = a + bt_i + e_i$$

where the *Y* are genre labels, *t* indicates years, 1, 2, …42, and e_i is an error term.

Table 2 shows resulting coefficients and their statistical significance for the 20 time series regressions. For consistency, the regressions reported are all corrected for autocorrelation in the error terms by the Prais-Winsten method, whether or not the original models passed or failed the Durbin-Watson test for autocorrelation.[7]

[Table 2 near here]

Eight of the 20 individual labels showed a significant increase over time at the 5% level. “Action,” followed by “adventure,” “fantasy,” and “thriller,” led the individual increases, while only three labels--“drama,” “musical,” and “western,” declined significantly, the former most dramatically.

The above results involving time trends in movie type prevalence since the 1960s may be misleading in an important respect. As the last row of Table 1 shows, the average number of genre labels assigned per movie by *imdb.com* increased steadily over the period from 2.6 in 1967-71 to 3.3 in 2002-06 and 3.6 in 2007-08. We could not be certain whether increases over time in the percentage of movies to which a particular genre was assigned occurred because of some change in the methodology of assigning genres or due to changes in the movies

[7] Among the comparable uncorrected regressions (which are not reported in Table 2), 3 among the 20 failed the DW test, and 4 were in an inconclusive zone (Greene 2008). For the deflated models, these proportions were 2 and 2, respectively. As a group, the uncorrected models showed a slightly higher rate of statistical significance, but these models also indicated no systematic pattern of consistency or inconsistency with the time series results for increasing/decreasing genre prevalence.

themselves. An interesting interpretation incidental to this study emerges from these data. Movie producers may have increasingly homogenized, that is, sought to broaden the audiences for major feature films in the sense of providing "something for everyone," thus requiring a larger number of genre labels.

In either case, to compare time trends in the genres with technology-intensiveness, which has no potentially comparable upward bias, we deflated time trends in all the individual genre labels by the average number of genres recorded per movie in each year. Regression results for the deflated genres also appear in Table 2. The regression coefficients were all lower for the deflated trend data, and as would be expected, there was less prevalence of recorded increases. Using the deflated measures, six of the 20 genres significantly increased, while five declined.

IV. Analysis of Technology Intensiveness

To identify technology-intensive movie genres, we relied upon end credits information for the Top 50 box office movies over the 1993-2005 period.[8] The relatively recent period to which this part of our analysis is confined is an evident shortcoming, but the deeper sampling creates a larger total sample of 650 films than the top 20 group would permit. For each movie, we calculated the percentage of total end credits that were accounted for by personnel in four broad groupings: "special effects," "visual (or digital, 3D graphics, related) effects," "stunt" artists, and "sound" technicians (TECH-broad). As a more narrow alternative measure, we calculated the proportion of total credits that were accounted for only by special effects and

[8] We did not attempt to code end credits for earlier years, since in the 1970s and 80s, a major transformation in motion picture industry practices toward more comprehensive end credits took place so that comparing credits information over a longer period would likely be misleading (Bart, 1994; Welkos, 1991). Where possible, we used a video of the actual film for the coding of credits. Where these were unavailable or unreadable, we relied upon *www.imdb.com*, excluding "uncredited" credits, which do not appear on the original film, but are contributed by users.

visual effects (TECH-narrow).[9] We then related these measures of technology intensiveness to the genre label information from www.imdb.com.

Table 3 displays summary analysis of technology-intensiveness for the 20 subject genres. The second and third columns of Table 3 show basic descriptive data by genre for variations around the sample mean of the two basic measures we employed. Although the broad measure (TECH-broad) had nearly twice the mean as the narrow measure (TECH-narrow), the pattern of results for the two measures is very similar. Technology-intensive credit counts for "action," "adventure," "animation," "family," "fantasy," "musical" and "sci-fi" are significantly above the mean by both measures, while "horror" is above it by only one of the measures. "Biography," "comedy," "crime," "drama," "music," "romance" and "sports" are below the mean by both measures. Overall, these results seem to correspond to popular notions of what types of films are technology-intensive.

[Table 3 near here]

Relying only upon these descriptive data to identify "technology-intensive" genres is still problematical because more than one genre is typically applied to each movie. A skew in the pairing of genres can thus lead to bias. Say, for example that genre "*A*" is a true driver of disproportionately high technology use, while genre "*B*" is actually neutral. If *B* happens to be paired with *A* relatively frequently, however, the descriptive data may indicate a misleadingly high level of technology-intensiveness for the *B* genre, due just to the influence of *A.*

[9] The present study uses an end credit coding scheme identical to that detailed in Waterman (2005), Appendix J, that was employed for a descriptive presentation of genre trends in 12 categories over the 1967-2001 period.

In an attempt to parse the “true” marginal effects of each genre label, we regressed the ratio of technology to total credits on the 20 different genre labels, where each genre was represented by a dummy variable (1 or 0), depending on whether the label applied, for the full sample of 650 movies. Results for these regressions are shown in the last two columns of Table 3. They show a very similar, though somewhat less pronounced, pattern of signage and significance for the various genre labels.[10] We did not encounter serious multi-collinearity in these models. All models are also estimated via OLS with robust standard errors to account for heteroskedasticity concerns. (Greene 2008)**.**

V. Comparison of Genre Trends with Technology-intensiveness

A summary of the correspondence between results of the technology-intensiveness genre analyses with the genre time trends since 1967 is shown in Table 4. For each one of the 11 genre labels that significantly increased or decreased in prevalence over the 1967-2008 period at the 5% level, the direction of change is indicated in column 3. In columns 4-7, corresponding signage of all results of the technology intensiveness analysis are shown. Both the differences from the means and the marginal effects measures are shown, since it is not obvious which of these measures is conceptually better.

[10] We also evaluated the technology-intensiveness of the subset of top 20 films for the same 1993-2005 period (260 films). To be expected, results were somewhat less significant (also at the 5% level) but were very similar. Fourteen of the genre labels showed the same result for some or all technology-intensiveness measures in both the top 20 and top 50. Five of the other six genre labels (horror, music, sport, thriller and western) had a significant technology-intensiveness measure for the top 50 films, but not the top 20. One genre (mystery) had a significant technology-intensiveness measure in one case for the top 20 films, but none for the top 50. There were no cases in which the technology-intensiveness measure had a different sign and was statistically significant in both the top 20 and top 50 film analysis.

[Table 4 near here]

A shortcoming of this analysis is the implicit assumption in the time trend regressions that advances in movie production technologies have been linear and continuous over time. The overall pattern of the results is nevertheless consistent with our hypothesis that genres which have significantly increased or decreased in prevalence over time among top films are the same genres that are relatively technology-intensive.

In 9 of the 11 cases, the time trend corresponds to significance of the technology-intensiveness measures in the same direction, although in 3 of those 9 cases ("adventure," "romance" and "western") one or more of the technology-intensiveness measures are not statistically significant. In only one of the 11 cases ("musical") is there a statistically significant inconsistency of time trend and technology-intensiveness. In the "musical" case, the time trend is negative, but two of the technology-intensiveness measures (the difference from the mean of TECH-broad and TECH-narrow) are positive (Both of the marginal effects measures are insignificant). Notably, however, "musical" was among the least prevalent genre labels in the top 20 films, appearing in only 5% of the 840 top 20 movies from 1967-2008. The one case in which a significant time trend was accompanied by no significant technology-intensiveness measures ("war") was the least prevalent of the 20 genre labels, appearing in only 3% of the films.

A further comparison of Tables 2 and 3 shows that there were several cases ("comedy," "romance," "crime," "horror," "sport," "music," and "biography") in which one or more significantly positive or negative technology-intensive measures correspond with an insignificant genre time trend. As noted above, however, there were no statistically significant inconsistencies in the direction of the effects other than for the "musical" case. Finally, if one considers statistical significance at the 10% level (Table 2), one other label, “history,” shows a negative time trend. There were no differences in technology-intensiveness for this label by any of the four measures.

VI. Summary and Conclusions

We have investigated long terms trends in movie genres and the economic forces underlying those trends. Our data indicate that from 1967 to 2008, several genre labels, (“adventure,” “family,” “fantasy,” “sci-fi,” “ animation,” and especially “action”) have become significantly more prevalent among the list of Top 20 box office movies in the U.S., while several others (“romance,” “musical,” “western,” “war,” and especially “drama”) have faded from the top films list.

Consistent with our primary hypothesis, we also find that the rising genres over this 42 year period have a strong tendency to also be “technology-intensive,” in terms of their reliance on special effects and related production technologies. The falling genres, with the one relatively minor exception of “musicals,” tend to be the least technology-intensive in their production process.

Our study is handicapped by measurement difficulties and an implicit assumption of linear change in technology over an extended period. Our results are evidence, however, that a massive shift of Hollywood’s production resources toward “high concept” action/adventure/ science fiction/fantasy/etc. blockbuster movies has occurred over the past several decades--because of the technology itself. Like video games, the most technology amenable film types can be made increasingly more exciting and alluring to audiences than in years past. Moreover, the declining cost of suspending disbelief in these movies has made them--other things equal--

cheaper to make than such technology-unamenable genres as "drama" and "romance." Movie characters can now be transported, transfigured, or killed in an incredible number of ways, but what can digital effects do for a kiss? Hollywood's production investments have naturally followed.

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Table 1

Genre trend analysis: the % of top 20 movies in which the label/index appears: 5-year averages, 1967-2008

	Total # of Appearances	67-71	72-76	77-81	82-86	87-91	92-96	97-01	02-06	07-08	Overall Average
Action	288	20	22	33	33	37	36	42	42	58	34
Adventure	250	20	20	27	31	20	31	36	44	53	30
Animation	55	4	2	2	2	4	7	11	14	23	7
Biography	18	2	6	1	3	1	1	1	3	0	2
Comedy	354	33	28	51	43	51	37	42	48	53	42
Crime	148	12	22	12	17	30	21	17	11	15	18
Drama	312	58	59	26	36	42	40	26	17	20	37
Family	145	13	15	12	11	20	16	21	25	30	17
Fantasy	123	5	7	13	11	18	15	18	25	28	15
History	21	4	5	2	2	1	3	0	3	3	3
Horror	47	2	5	8	5	7	5	11	3	3	6
Music	20	2	2	3	4	2	3	0	2	5	2
Musical	39	9	10	6	4	3	5	2	0	0	5
Mystery	72	7	7	7	7	6	13	12	11	5	9
Romance	179	23	18	24	20	22	26	21	19	15	21
Sci-Fi	111	6	6	13	15	13	12	16	23	18	13
Sport	40	4	4	6	8	3	6	3	6	0	5
Thriller	273	16	31	27	27	40	45	40	33	35	33
War	29	9	2	4	1	4	3	2	2	5	3
Western	31	12	9	1	1	4	2	2	0	0	4
Average # of Genres per Movie		2.6	2.8	2.8	2.8	3.3	3.3	3.2	3.3	3.6	3.1

Sources: IMDB

Table 2

Individual genre time trend regression coefficients, 1967 – 2008

	Undeflated		Deflated	
Action	0.702	(7.3)**	0.459	(4.4)**
Adventure	0.681	(5.1)**	0.449	(3.2)**
Animation	0.397	(5.3)**	0.337	(5.2)**
Biography	-0.052	(1.3)	-0.066	(1.7)
Comedy	0.387	(2.0)**	0.084	(0.3)
Crime	0.010	(0.1)	-0.080	(0.5)
Drama	-0.947	(4.2)**	-1.129	(6.3)**
Family	0.380	(4.1)**	0.248	(3.0)**
Fantasy	0.503	(5.9)**	0.399	(4.6)**
History	-0.063	(1.3)	-0.083	(1.7)*
Horror	0.033	(0.5)	-0.002	(0.0)
Music	-0.012	(0.3)	-0.033	(0.7)
Musical	-0.262	(5.6)**	-0.300	(6.1)**
Mystery	0.113	(1.7)*	0.048	(0.7)
Romance	-0.069	(0.8)	-0.212	(2.7)**
Sci-Fi	0.350	(3.8)**	0.251	(2.6)**
Sport	-0.022	(0.5)	-0.046	(1.0)
Thriller	0.477	(2.8)**	0.267	(1.6)
War	-0.089	(1.6)	-0.125	(2.1)**
Western	-0.261	(3.6)**	-0.309	(4.2)**
N (for each individual regression)		42		42

Notes:
t-values in parentheses.
Coefficient significance levels: ** 5%, * 10%.
All regression models using Prais-Winston time series regression.

Table 3

Technology-Intensiveness analysis (top 50 movies), 1993-2005

		Difference from overall mean		Marginal effect	
	N	**TECH-broad**	**TECH-narrow**	**TECH-broad**	**TECH-narrow**
Action	229	+0.093 (4.6)**	+0.058 (2.8)**	0.125 (5.4)**	0.069 (3.0)**
Adventure	189	+0.158 (6.7)**	+0.162 (6.8)**	0.040 (1.4)	0.057 (2.0)**
Animation	50	+0.467 (10.2)**	+0.521 (11.3)**	0.373 (3.6)**	0.400 (3.8)**
Biography	16	- 0.172 (2.3)**	- 1.440 (2.0)**	- 0.067 (1.9)*	- 0.046 (1.3)
Comedy	294	- 0.045 (2.3)**	- 0.041 (2.1)**	- 0.096 (4.4)**	- 0.105 (5.0)**
Crime	117	- 0.073 (2.8)**	- 0.104 (3.9)**	- 0.029 (1.9)*	- 0.045 (3.2)**
Drama	256	- 0.073 (3.8)**	- 0.067 (3.4)**	- 0.062 (3.8)**	- 0.055 (3.4)**
Family	126	+0.194 (6.4)**	+0.219 (7.0)**	0.096 (3.3)**	0.096 (3.2)**
Fantasy	111	+0.145 (5.1)**	+0.162 (5.7)**	0.069 (2.5)**	0.079 (2.8)**
History	11	+0.004 (0.1)	+0.022 (0.3)	- 0.004 (0.1)	0.020 (0.3)
Horror	52	+0.062 (1.6)*	+0.068 (1.7)**	0.069 (2.9)**	0.079 (3.5)**
Music	13	- 0.161 (2.1)**	- 0.146 (1.9)**	- 0.061 (2.6)**	- 0.062 (2.7)**
Musical	18	+0.476 (6.9)**	+0.539 (7.7)**	0.178 (1.3)	0.197 (1.5)
Mystery	66	- 0.046 (1.3)*	- 0.042 (1.2)**	- 0.037 (1.8)*	- 0.036 (1.9)*
Romance	134	- 0.089 (3.2)**	- 0.072 (2.6)**	- 0.003 (0.1)	0.010 (0.3)
Sci-fi	82	+0.159 (2.1)**	+0.175 (5.4)**	0.071 (2.7)**	0.107 (4.2)**
Sports	27	- 0.115 (2.1)**	- 0.097 (1.8)**	- 0.028 (0.9)	- 0.023 (0.9)
Thriller	235	+0.004 (0.2)	- 0.016 (0.8)	- 0.003 (0.2)	- 0.012 (0.6)
War	20	- 0.018 (0.3)	- 0.040 (0.6)	0.039 (1.1)	0.021 (0.7)
Western	9	- 0.055 (0.6)	- 0.111 (1.2)	- 0.031 (0.7)	- 0.082 (2.7)**
Overall Mean		0.373	0.223		
Intercept				0.321 (13.2)**	0.182 (7.8)**
R-square				0.44	0.47
F(20, 7)				22.5**	21.0**
N				650	650

Notes:
t-values in parentheses, calculated with robust standard error.
Coefficient significance measure: ** 5%;* 10%

Table 4

Summary comparisons of genre trends and technology-intensiveness results: the 11 genres having a significant trend over time

Genres with significant time trend coefficients (at 5% level)	**Total number of movies in which the genre appears, 1967-2008**	**Direction of change, 1967-2008**	**Difference from Overall Mean**		**Marginal Effect**	
			TECH- broad	**TECH-narrow**	**TECH- broad**	**TECH-narrow**
Action	288 (34%)	+	+	+	+	+
Adventure	250 (30%)	+	+	+		+
Animation	55 (7%)	+	+	+	+	+
Drama	312 (37%)	–	–	–	–	–
Family	145 (17%)	+	+	+	+	+
Fantasy	123 (15%)	+	+	+	+	+
Musical	39 (5%)	–	+	+		
Romance	179 (22%)	–	–	–		
Sci-Fi	111 (13%)	+	+	+	+	+
War	29 (3%)	–				
Western	31 (4%)	–				–

Figure 1

Trends in the Five Most Prevalent Genres; Top 20 Box office Movies in the U.S., 1967 - 2008