Copyright Law and the Supply of Creative Work: Evidence from the Movies

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There is almost no empirical evidence on the extent to which copyright law works in the sense of increasing the production of creative work. Here, we study the impact of two major changes in copyright law – the extension of copyright term and the European Rental Directive – on the production of movies.

In a panel of 23 OECD countries, among which 19 extended copyright term at various times between 1991-2005, we found no statistically robust evidence that copyright term extension was associated with higher movie production.

In a panel of 17 European countries between 1991-2005, we found no statistically robust evidence that compliance with the Rental Directive was associated with higher movie production.

The extension of copyright term and European Rental Directive were particularly pertinent to the movie industry. Movies are particularly long-lived, the Rental Directive specifically addressed the movie industry, and, unlike other copyrightable products, sequential innovation is not important in movies. Hence, if major changes in copyright law had no discernable impact on movie production, it seems the case for copyright law is weak indeed.

* National University of Singapore. Corresponding author: Ivan Png, NUS Business School, 1 Business Link, Singapore 117592, Tel: +65 6516-6807, http://www.comp.nus.edu.sg/~ipng/ This paper combines two earlier papers, "Copyright Duration and the Supply of Creative Work" and "Copyright Law and Movie Production: the European Rental Directive". We gratefully acknowledge financial assistance from the IP Academy of Singapore and the Center for the Analysis of Property Rights and Innovation, University of Texas at Dallas, and the hospitality of Nuffield College, Oxford, at which part of this work was undertaken. We thank Matthew Baker, Brendan Cunningham, Winand Emons, Gerald Dworkin, Ken Sokoloff, Arun Sundararajan, Andre Lange, Kai-lung Hui, David Levine, Julian Wright, Mark Glancy, Patricia Funk, Yuan Yuan Chen, and participants at the 2005 IOMS Workshop, the 2006 SERCI Congress, the 2007 AEA meetings and seminars at the University of Oxford, the H.K. University of Science and Technology, the Chinese University of Hong Kong, the University of Washington and University of Tokyo for helpful advice, and Chin Kah Jin and Jessica Waye for able research assistance.

1. Introduction

Article 1, Section 8, Clause 8 of the U.S. Constitution (the so-called "Patent and Copyright Clause") provides that, "The Congress shall have power ... To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries."

As the Patent and Copyright Clause suggests, generally, copyright must strike a delicate balance between two considerations:

- Broader and longer protection increases the return to creators of new work, and in the long term, encourages more creative work;
- Narrower and shorter protection increases the use of existing creative work, and hence, raises the benefit to end-users and also facilitates new creations that build upon earlier work.

There is no disagreement about the directions of these two considerations (Plant 1934; Gallini and Scotchmer 2002). Recent theoretical analyses have shown that creators might be sufficiently motivated by first-mover advantage (Boldrin and Levine 2002 and 2008), so that stronger copyright might not affect the creation of new work. Indeed, whole industries have arisen without the protection of copyright. Examples include academic works, open-source software, and the collection of material on the Internet generally called "Web 2.0".

The theoretical analyses and rapid growth of non-copyrighted industries beg the question of the extent to which copyright law even works – in the sense of increasing the production of creative work. If copyright law was weakened, would more or less software, movies, music, and books be created? How much more or less? There is almost no empirical evidence on this issue (Png 2006).

Notwithstanding the absence of empirical evidence, the various industries have pressed relentlessly for the expansion of copyright. For instance, between 1988-2007, the U.K. Copyright Act was amended 14 times, while, between 1976-2007, the U.S. Copyright Act was amended 49 times. Under the auspices of free trade negotiations, the United States has compelled various countries, including Singapore, Chile, and Australia to expand copyright law and enforcement.

Here, we study the impact of two major changes in copyright law – the extension of copyright term and the European Rental Directive – on the production of movies. We

focus on movies for various reasons. Unlike software, databases, and books, there is little sequential innovation in movies. Rarely does one director cut and paste older movies to make a new one. In the absence of sequential innovation (Scotchmer 1991; Bessen and Maskin forthcoming), the impact of copyright law on movie production should be positive.

Beginning in 1993, various European countries extended the term of copyright from author's life plus 50 years to author's life plus 70 years. From 1998 onward, the United States and other countries followed. In 2002, the U.S. Supreme Court heard the *Eldred* case,[1] which challenged the Sonny Bono Copyright Term Extension Act (CTEA). In an *amici curiae* brief (Akerlof et al. 2002), five Nobel laureates and twelve other economists argued that, in present value terms, the extension of copyright term provided a very small return, and hence would have little impact on the creation of new works. Justice Breyer (2003), page 14, quoted the brief with approval, "any added incentive to create new works in the future is insignificant". However, Liebowitz and Margolis (2005) countered that the impact depended on the elasticity of supply of new works, which might be high.

We studied a panel of 23 Organisation for Economic Co-operation and Development (OECD) countries, among which 19 extended copyright term at various times between 1991-2005. We found no statistically robust evidence that copyright term extension was associated with higher movie production. This negative finding spanned various specifications and sub-samples, accounting for lags, outliers, and possible omitted variables such as government funding, and also with respect to the production of music CDs and books.

Beginning in 1992, various European countries revised their copyright laws to comply with the Rental Directive, which specified rental and lending rights, and copyrights for performers, music and film producers, and broadcasters. These changes were part of a broad effort to harmonize laws and regulation and remove barriers to trade within the European Union.

We studied a panel of 17 European countries during the period 1991-2005. We found no statistically robust evidence that compliance with the Rental Directive was associated with higher movie production. This negative finding spanned various specifications and sub-samples, including the specification of compliance, accounting for lags, outliers, and possible omitted variables such as government funding, and also with respect to the production of music CDs and books.

Apparently, two major changes in copyright law had no significant effect on creation of new work in a significant copyright-protected industry – movies. Our results provide empirical support for theoretical analyses that stronger copyright would not increase the production of creative work in the industries and samples that we analyzed.

2. Previous Research

Surprisingly, despite persistent controversy, there has been relatively little empirical research into the impact of copyright law on the production of creative work (Png 2006).

Until 1891, U.S. copyright law did not provide any protection to foreign authors. Then, Congress passed the International Copyright Act, which provided copyright protection to foreign authors, and through reciprocal recognition, provided copyright protection to U.S. authors in foreign jurisdictions. The Act did not have a substantial impact on the number of full-time authors in the United States (Khan 2004).

The U.S. Sonny Bono Copyright Term Extension Act (CTEA) of 1998 motivated several studies. The CTEA had positive but insignificant effects on U.S. movie production (Hui and Png 2002), and U.S. copyright registrations (Landes and Posner 2003). Related to the CTEA, two studies reported on the longevity of copyrighted work. In 1998, 40% of movies created in 1929-1932 and 65% of those created in 1933-1941 were still being played commercially (Rappaport 1998). Liebowitz and Margolis (2005) observed that, of a sample of 236 titles reviewed by *Book Review Digest* in the 1920s, 41% were still in print 58 years later. They remarked that, while the additional return to creators from copyright term extension might be small in present value, the impact on new works depended on the elasticity of supply, which might be high.

Through extensive legal research, Reynolds (2003) compiled an index of copyright law for multiple countries. He found that the numbers of movies submitted to the Cannes Film Festival in a sample of 81-136 countries between 1965-2002 was positively and significantly related to his copyright index, and was positively, but not significantly, related to copyright term.[2]

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[1] Eric Eldred et al., v. John D. Ashcroft, Attorney General, U.S. Supreme Court, No. 01-618.

[2] Reynolds' (2003) results should be interpreted with caution. The mean number of submissions was 0.34 with a standard deviation of 1.60, suggesting that the data comprised many zeroes with a few positive integers. With a count dependent variable, the usual ordinary least squares test statistics are not valid.

Baker and Cunningham (2005) provided the strongest empirical evidence of the incentive effect of copyright law to date. Court decisions broadening copyright protection were associated with increases in copyright applications in Canada and the United States. In addition, copyright applications were higher when the economic growth was slower, which is consistent with creative activity being complementary with leisure.

Besides the contribution of Baker and Cunningham (2005), the impact of copyright law on the production of new creative work continues to be an open question.[3]

3. Copyright Term

On October 29, 1993, the European Economic Community (EEC) Council of Ministers issued Directive 93/98/CEE to harmonize the term of protection of copyright and certain related rights with effect from July 1, 1995.[4] This so-called "Copyright Term Directive" was just one of multiple Directives issued to harmonize copyright laws with the overall objective of establishing a single European market. The EEC became the European Union (E.U.) with effect from November 1, 1993.

Prior to the issuance of the Directive, copyright term differed in the various E.U. member states.[5] For literary, dramatic, musical and artistic works, the Directive specified a term of author's life plus 70 years, while, for audiovisual works, the Directive specified a term of 70 years following the death of the last survivor among the principal director, the screenplay and dialogue authors, and the music composer. Significantly, the extension of term applied *retroactively* to any existing work with copyright still in force.

At the time of the Directive, German copyright law specified a term of the author's life plus 70 years, which was the longest among the E.U. member states. The Commission decided to increase the term elsewhere to match the copyright term in Germany. Politically, this was the most convenient choice (Dworkin 1994). At various dates between 1993-1997,

[3] Various studies have shown that copyright law does affect creator's earnings (Baker and Cunningham 2006; Boyle, O'Connor, and Nazzaro 2008), without considering the impact, if any, on production. Building on various empirical studies, Pollock (2008) analyzed the optimal copyright term.

[4] Directive 93/98/CEE, *O.J.* No. L 290 of 24 November 1993.

[5] Most countries conformed to the Berne Convention for the Protection of Literary and Artistic Works, which provided a term of the author's life plus 50 years (Brownlee 1996: 596). For cinematographic works, the Berne Convention provided a term of 50 years from the publication or making of the work.

the E.U. member states revised their laws to implement the Directive.[6]

The Copyright Term Directive had a broader impact. Notably, pursuant to the Agreement on the European Economic Area (EEA) of 1992, European Free Trade Area (EFTA) member states, Austria, Finland, Sweden, Norway, Iceland, and Liechtenstein, committed to harmonize their laws with those of the E.U. (Gotzen 1998).[7] The EEA Agreement took effect in 1994. Although an EEA member, Switzerland did not accede to the EEA Agreement. In addition, the various Central and East European countries seeking E.U. membership, including the Czech Republic, Hungary, Poland, and Slovakia, also had to conform.

Further, in 1998, the U.S. Congress passed the Sonny Bono Copyright Term Extension Act (CTEA) to align copyright term in the United States with that in the E.U. This allowed U.S. copyright owners to enjoy reciprocal copyright term extension in E.U. member countries.[8] The CTEA was challenged as unconstitutional, but upheld by the Supreme Court in 2002.[9] Under the auspices of free trade negotiations, the United States has compelled various countries, including Singapore, Chile, and Australia to expand copyright law and enforcement.

Through extensive legal research, we compiled Table 1, which reviews legal changes, if any, with respect to the term of copyright protection in OECD member countries between 1991-2005. Only four OECD members did not extend copyright term during the period – Canada, Germany, Korea, and New Zealand.[10]

-- Table 1. Changes in copyright term, 1991-2005 --

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[6] The academic literature (Brownlee 1996: footnotes 12 and 90), Bard and Kurlantzick (1999), pp. 16-17) gives no indication that industry influenced the timing of the revisions of national copyright laws.

[7] Agreement on the European Economic Area of 2 May 1992 (*O.J.* No. K 1 of 3 January 1994), Protocol No. 28.

[8] Directive 93/98/CEE, Article 7, specifically provided that the copyright term extension would not apply to works created outside the E.U. Accordingly, foreigners could benefit from longer copyright in the E.U. only if similar legislation were enacted in their home countries (Bard and Kurlantzik (1999), page 175).

[9] Eric Eldred et al., v. John D. Ashcroft, Attorney General, U.S. Supreme Court, No. 01-618.

[10] Germany extended its copyright term to author's life plus 70 years in 1965. Austria already complied with the Copyright Term Directive for all works except movies, hence it had to revise its law to extend the copyright term for movies only. Canada and New Zealand extended copyright term in 1994, but only minimally, so, we ignored these changes.

The extension of copyright term was particularly pertinent to the movie industry. Among the various forms of copyrightable work, movies are particularly long-lived (Rapapport 1998), hence movie producers would benefit relatively the most from extension of copyright term. This is another reason, besides the absence of sequential innovation, to focus on movies in studying the impact of copyright term extension.

3.1 Data and Specification

The Internet Movie Database ("IMDb") proclaims itself to be "Earth's biggest movie database" and is sponsored by Amazon.com. Using IMDbPro, we extracted information about various characteristics of movies created in OECD member countries between 1991-2005. Referring to Table 2, for each country and year, we obtained information from Euromonitor International's Global Market Information Database (GMID) about other national characteristics that might possibly affect movie production – population, GDP per capita, personal computer (PC) ownership, internet usage, and real interest rates. Owing to limitations of data, our study was limited to 23 countries.[11]

-- Table 2. OECD movie industry: Descriptive statistics --

Our empirical strategy was to employ difference-in-differences, exploiting differences among countries as to whether they did or did not extend copyright term, and among those that did so, in the timing of the extensions. The "difference in differences" specification accounted for any general changes in market or technological conditions that might possibly have affected the incentive to produce movies when the Directive took effect (Bertrand et al. 2004). We specified

$$\log(\text{MOVIES}_{it}) = f(\text{TERM}_{it}, X_{it}). \qquad (1)$$

The dependent variable was the natural logarithm of the number of movies created in that country-year, while, among the explanatory variables, TERM_{it} was the number of years by which the term of copyright was extended, and X_{it} was a vector of other variables that might possibly have affected movie production. Unless otherwise stated, all variables were specified in natural logarithms, and to minimize multi-collinearity, all demographic variables other than population were specified on a per capita basis.

An immediate concern was secular differences in national vis-a-vis international

[11] These reasons are explained in Table 2, note 1.

co-production of movies, as illustrated by Figure 1. To account for this, we specified the dependent variable in two ways. Our main estimates focused on the number of movies adjusted by the number of co-producing countries, e.g., if a movie was produced in the U.S. and Germany, then it would contribute 0.5 to the number of movies created in the U.S. and Germany respectively for that year. In a robustness check, we disregarded movies with co-productions and specified the dependent variable as nationally-produced movies.[12]

-- Figure 1. Nationally and co-produced movies (logarithm) --

As a preliminary, Figure 2 depicts, for each country, the time profile of movie production and the effective date of copyright term extension, if any. Apparently, there was no discernable impact of copyright term extension on movie production.

-- Figure 2. Movie production (logarithm) and copyright term extension --

3.2 Estimates

Our baseline specification of model (1) was a regression of movie production on copyright term extension, as well as various demographic and financial characteristics – GDP per capita, population, computer ownership and internet access, and real interest rate, with year and country fixed effects. As a preliminary, we tested for and detected heteroskedasticity but not serial correlation. Accordingly, we estimated the baseline specification using feasible generalized least squares, as this procedure is more efficient than ordinary least squares in the presence of heteroskedasticity (Wooldridge 2006: 290-293, 428-429).

-- Table 3. Copyright term extension --

Table 3, column (a), reports the results. The coefficients of GDP per capita and population were positive and significant, while the coefficient of the real interest rate was negative but imprecisely estimated. The coefficient of copyright term extension was negative but very marginally significant. The 95% confidence interval for the impact of extending copyright term from author's life plus 50 years to author's life plus 70 years on movie production was (–12.76%, 0.52%). By a one-tailed test, the hypothesis that copyright term extension had a positive impact on movie production was rejected with p = 0.029.

[12] To collect the data, we queried the IMDbPro by country and year, and then matched movies by title. Accordingly, we could only adjust for co-production among the OECD member countries.

To check the robustness of the results, we also did the following. First, we specified copyright term extension as an indicator rather than in the number of years by which term was extended. Table 3, column (b), reports the results. The coefficients of the covariates other than the indicator of copyright term extension were substantially the same as in the baseline estimate. As might be expected with a coarser specification of the policy variable, the estimated impact of copyright was less precisely estimated. The 95% confidence interval for the impact of copyright term extension was (–6.45%, 10.45%).

Next, we estimated model (1) with the dependent variable specified as nationally-produced movies, i.e., excluding co-productions. Table 3, column (c), reports the results. Compared with the baseline estimate, the major differences were that the coefficient of GDP per capita was not significant, while the coefficient of the real interest rate was negative and significant. The coefficient of copyright term extension was negative and significant. The 95% confidence interval for the impact of copyright term extension on movie production was (–14.94%, 0.04%). By a one-tailed test, the hypothesis that copyright term extension had a positive impact on movie production was rejected with $p = 0.019$.

Another possible source of measurement error was the data on movie production. As an alternative to IMDB, we acquired information on movie production from Film Index International (FII), a proprietary database compiled by the British Film Institute. We estimated the baseline specification using the FII movie data. Table 3, column (d), reports the results. Compared with the baseline estimate, the major differences were that the coefficient of population was negative and marginally significant, while the coefficient of the real interest rate was negative and significant. The coefficient of copyright term extension was negative but imprecisely estimated. The 95% confidence interval for the impact of copyright term extension on movie production was (–14.48%, 23.94%).

IMDB covered a larger number of movies than FII. The correlation between the two data sets by country ranged between –0.2384 and 0.7135. To the best of our knowledge, all previous studies of the movie industry have used IMDB rather than FII. Accordingly, we prefer the baseline estimates, which used IMDB data.

Next, we considered the impact of anticipation and lags. The Copyright Term Directive was issued in October 1993, after substantial discussion (Dworkin 1994). Since the Directive was retrospective, movie studios might have expanded production ahead of legislation. In Table 3, column (e), we specified the effective date of copyright term

extension as 1993 for the original E.U. member states. Relative to the baseline estimate, the major difference was that the coefficient of copyright term was positive, but not significant. This was possibly consistent with the notion that producers anticipated the change in law. However, the 95% confidence interval for the impact of copyright term extension on movie production was (–3.62%, 12.30%). Accordingly, it is difficult to accept that copyright term extension had a significant impact on movie production.

Movie production takes time -- at least 18 months between conception and release (Vogel 2004: 53-55). We estimated model (1) with all time-varying covariates specified with a one-year lag, so, movie production in year t was regressed on co-variates for year t – 1. Table 3, column (f), reports the results. Relative to the baseline estimate, the major differences were that the coefficient of population was positive but not significant, and the coefficient of the real interest rate was positive and marginally significant, which results seem to cast doubt on this specification. The coefficient of copyright term extension was negative but imprecisely estimated. By a one-tailed test, the hypothesis that copyright term extension had a positive impact on movie production was rejected with $p = 0.105$.

We then checked for sensitivity to the sample countries. To account for the possible influence of outliers, we also estimated model (1) using the Stata procedure, robust regression, an iterative procedure which assigns larger weights to better behaved observations. Table 3, column (g), reports the results. Relative to the baseline estimate, the major differences were that the coefficient of population was smaller and not significant, and the coefficient of copyright term extension was smaller in absolute value and not precisely estimated. By a one-tailed test, the hypothesis that copyright term extension had a positive impact on movie production was rejected with $p = 0.105$.

Besides measurement error, timing, and sample selection, another possible source of bias was omission of relevant explanatory variables. The E.U. and member states systematically targeted movie production with government funding and tax incentives (Lange and Westcott 2004). However, the only source of data on government incentives for movie production that we could find was the European Audiovisual Observatory's KORDA online database and earlier publications. This provides only information about government funding, and the coverage for the early 1990s is fragmentary.

Using the Observatory data, we re-estimated model (1) including government funding as an additional explanatory variable. Owing to limited data, the sample size was reduced by more than half. Table 3, column (h), reports the results. The coefficient of

GDP per capita was negative and significant, which calls the estimate into question. However, the estimate was consistent with the baseline estimate in that the coefficient of copyright term extension was negative and significant. By a one-tailed test, the hypothesis that movie production was positively related to copyright term extension was rejected with $p = 0.000$.

To sum up, having considered various specifications, anticipation and lags, alternative sub-samples and data sources, and possible missing variables, we found that copyright term extension did not have a significant impact on movie production.

3.3 Music and Books

As a further check of the robustness of our findings, we tested the impact of the copyright term extension on the production of music CDs and books. We collected data on music CDs from the International Federation of the Phonographic Industry, and on books from the International Publishers Association (IPA) and UNESCO.

-- Table 4. Copyright term extension: Music and books –

Table 4 reports estimates of the baseline specification of model (1). The results were not very precise owing to the limited data on music CDs and books. For music, only the estimate for CD albums (Table 4, column (a)) seemed intuitively reasonable. The coefficients of GDP per capita and population were positive and significant, while the coefficient of the real interest rate was negative, albeit imprecisely estimated. The 95% confidence interval for the impact of copyright term extension on movie production was (–5.92%, 3.72%).

For books, only the estimate using IPA data (Table 4, column (c)) seemed intuitively reasonable. The coefficients of GDP per capita and population were positive and the coefficient of the real interest rate was negative, albeit imprecisely estimated. The 95% confidence interval for the impact of copyright term extension on movie production was (–7.49%, 5.09%).

To the extent that these estimates were reasonable, they confirm our earlier finding that copyright term extension did not have a significant impact on movie production extended to music and books as well.

4. European Rental Directive

On November 19, 1992, the EEC issued Directive 92/100/EEC to harmonize copyright laws with regard to rental and lending, and neighboring rights for performers, music and film producers, and broadcasters with effect from July 1, 1994.[13] Like the Copyright Term Directive, the so-called "Rental Directive" was issued to harmonize copyright laws with the objective of forming a single European market.

Prior to the issuance of the Rental Directive, copyright law in European countries differed in whether creators of works could control rental and lending. Differences between the copyright laws of Denmark and U.K. came to a head in the *Warner-Metronom*e case.[14] A Danish national bought video-tapes in the U.K. and offered them for rental in Denmark. The producer of the video-tapes sued to control rental of the tapes. Under Danish law, the producer could control rental, but not under U.K. law.[15]

Also, prior to the Directive, copyright law in European countries differed in the scope of "neighboring rights" of creators other than authors. In particular, the Rome Convention provided neighboring rights to performers, music producers, and broadcasters, *but not movie producers* (Geller 1999: Section 4[2][c][ii]).

The key changes required by Directive 92/100/EEC were:

- Article 1: exclusive rental and lending rights;
- Article 2: director of audiovisual work to be an author, presumption of transfer of rights from performers to audio-visual producers, optional presumption of transfer of rights from authors to audio-visual producers;
- Article 4: author and performer to have unwaivable right to equitable remuneration from rental;
- Article 5: exception from exclusive lending right;

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[13] Council Directive 92/100/EEC of 19 November 1992 on rental right and lending right and on certain rights related to copyright in the field of intellectual property, *O.J.* No. L 346 of 27 November 1992, 616-66. "Neighboring rights" are the European civil law name for the rights of creators, such as performers, music and movie producers, and broadcasters, who are not authors. In Anglo-Saxon common law, these rights are called copyrights.

[14] Judgment of 17 May 1988, Case 158/86, Warner Brothers Inc. and Metronome Video Aps. v. Erik Viuff Christiansen, [1988] E.C.R. 2605.

[15] U.S. law does not allow the producer of a pre-recorded video-tape to control rental. Mortimer (2007) estimated the impact of such control on U.S. consumer welfare, and movie producer and retailer profits.

- Articles 6-9: (neighboring) rights of fixation, reproduction, broadcasting and communication to the public, and distribution for performers, music and movie producers, and broadcasters.

Based on the survey by Reinbothe and von Lewinksi (1993), we compiled in Table 5 the compliance of existing national copyright law among E.U. and EFTA members with Articles 1, 2, 4, 5, and 6-9 of the Rental Directive. By our own further legal research, we tabulated the compliance of national copyright law in three countries – the Czech Republic, Hungary, and Poland – that subsequently joined the European Union.[16]

-- Table 5. Compliance with Rental Directive --

An entry "1" indicates that the national copyright law complied with the corresponding Article of the Rental Directive.[17] Where the national law did not comply with the Directive (as indicated by "0"), the national law had to be revised. For the effective dates of the revisions of the national law to comply with the Rental Directive, we relied on a study by the European Commission (undated) and our own legal research.[18] Following several revisions, the Rental Directive was superseded by Directive 2006/115/EC, issued on December 12, 2006.[19]

The Rental Directive was particularly pertinent to the movie industry. It was issued specifically to address an inconsistency in rental rights between U.K. and Denmark. Further, it closed a gap left by the Rome Convention, which provided neighboring rights to performers, music producers, and broadcasters, but not movie producers. These are additional reasons, besides the absence of sequential innovation, to focus on movies in studying the impact of the Rental Directive.

4.1 Data and Specification

As with the study of copyright term, we collected data on movie production from the

[16] Our own legal research was based on Geller (1999) and the online collection of copyright laws provided by the World Intellectual Property Organization (http://www.wipo.int/clea/en/index.jsp).

[17] Where relevant, Table 5 focused on the changes as they affected movie producers.

[18] According to the European Commission (undated), as of 1999, Ireland had not complied with the Rental Directive. Ireland passed the relevant legislation in 2000, but the effective date was not clear. For the baseline estimate, we assume that the effective date for Ireland was 2000. We also estimated the baseline specification with the effective date for Ireland as 1994, and found similar results (unreported).

[19] *O.J.* No. L 376 of 27 December 2006, 28-35.

IMDB and applied a difference in differences estimation strategy, exploiting differences among countries as to when and the extent to which they revised their copyright law to conform with the Rental Directive. We specified movie production in country *i* and year *t* as

$$\log(\text{MOVIES}_{it}) = f(\text{DIRECTIVE}_{it}, X_{it}), \qquad (2)$$

where DIRECTIVE_{it} was an measure of compliance with the Rental Directive in country *i* and year *t*, and X_{it} was a vector of other variables that might possibly affect movie production.

Referring to Table 5, the survey of Reinbothe and von Lewinksi (1993) and our own legal research was incomplete for compliance with Articles 5, 6, and 8 of the Rental Directive. Intuitively, the public lending right (Article 5) and right of first fixation for performers (Article 6) seemed relatively unimportant to movie producers. Further, Article 8 applied to performers, music producers, and broadcasters only (Reinbothe and von Lewinski 1993: 92). Hence, we disregarded these Articles.

With regard to the other indicators of compliance – with Articles 1 (rental), 1 (lending), 3 (presumption of transfer), 4 (unwaivable right of remuneration), 7 (reproduction), and 9 (distribution), our information on compliance was almost complete. However, as reported in Table 6, the indicators were highly collinear. Rather than omit particular indicators, we applied principal components analysis to generate one composite measure of compliance from the six indicators.[20]

-- Table 6. Indicators of compliance with Rental Directive: Correlations --

We used the same data-set as for the study of copyright term extension, except that our study of the Rental Directive was limited to European countries as the Directive did not apply elsewhere. As a preliminary, Figure 3 illustrates, for each European country, movie production and the degree of compliance with the Directive over the period 1991-2005. The graphs suggest that the Rental Directive did not have any systematic impact on movie production.

-- Figure 3. Movie production (logarithm) and compliance with Rental Directive --

[20] We checked the robustness of this approach by using the alternative of building a composite indicator by simply adding the six compliance indicators. The results were similar.

4.2 Estimates

Our baseline specification of model (2) was a regression of movie production on compliance with the Rental Directive, as well as various demographic and financial characteristics – GDP per capita, population, computer ownership and internet access, and real interest rate, with year and country fixed effects. As a preliminary, we tested for and detected heteroskedasticity but not serial correlation. Accordingly, we estimated the baseline specification using feasible generalized least squares, as this procedure is more efficient than ordinary least squares in the presence of heteroskedasticity (Wooldridge 2006: 290-293, 428-429).

-- Table 7. Impact of compliance with Rental Directive --

Table 7, column (a), reports the baseline estimate. The coefficients of GDP per capita and population were positive and significant, but the coefficient of the real interest rate was negative, albeit insignificant. The coefficient of the compliance indicator was negative and marginally significant. An instructive measure of the impact of the Rental Directive is the effect of increasing from zero to 100% compliance with the Directive. Based on the mean number of movies produced, the 95% confidence interval for the impact of increasing from zero to 100% compliance on movie production was (–27.02%, 2.22%). By a one-tailed test, the hypothesis that copyright term extension had a positive impact on movie production was rejected with $p = 0.0328$.

We checked the robustness of our findings in the following ways. First, we re-estimated model (2) using national productions instead of movies adjusted for co-production. As reported in Table 7, column (b), the results were very similar to the baseline estimate, except that the coefficient of the compliance indicator was less precisely estimated. Accordingly, the 95% confidence interval for the impact of increasing from zero to 100% compliance on movie production was somewhat wider at (–31.84%, 5.24%).

Next, we checked the sensitivity of our results to the measure of compliance. An alternative indicator was simply the sum of the indicators of compliance with Articles 1 (rental), 1 (lending), 3 (presumption of transfer), 4 (unwaivable right of remuneration), 7 (reproduction), and 9 (distribution). As reported in Table 7, column (c), the results were almost identical to the baseline estimate. The 95% confidence interval for the impact of increasing from zero to 100% compliance on movie production was (–26.90%, 2.30%). By a one-tailed test, the hypothesis that copyright term extension had a positive impact on movie production was rejected with $p = 0.0336$.

Next, we considered the effect of anticipation and lags. The Rental Directive was issued in November 1992, after substantial discussion (Reinbothe and von Lewinksi 1993). Since the Directive was retrospective, movie studios might have expanded production ahead of legislation. We re-estimated model (2) with the effective date of the Rental Directive specified as 1992 for the original E.U. member states. As reported in Table 7, column (d), the results were similar to the baseline estimate except that the coefficient of the compliance indicator was positive, albeit not significant.

This result was reminiscent of a similar result in our analysis of copyright term extension above. It was possibly consistent with the notion that producers anticipated the change in law. However, the 95% confidence interval for the impact of the Rental Directive on movie production was (–5.87%, 46.27%). Accordingly, it is difficult to accept that the Rental Directive had a significant impact on movie production.

As noted above, movie production takes time. To check the sensitivity to lags in movie producers' response to the Rental Directive, we re-estimated model (2) with all time-varying covariates specified with a one-year lag. As reported in Table 7, column (e), the results were similar to the baseline estimate. The coefficient of the compliance indicator was negative but not significant, and provided the 95% confidence interval for the impact of the Rental Directive on movie production as (–26.07%, 4.67%). By a one-tailed test, the hypothesis that copyright term extension had a positive impact on movie production was rejected with $p = 0.0671$.

We then checked for sensitivity to the sample countries. To account for the possible influence of outliers, we re-estimated model (2) using the Stata procedure, robust regression. As reported in Table 7, column (f), the results were similar to the baseline estimate except that the coefficient of the compliance indicator was not precisely estimated. The 95% confidence interval for the impact of the Rental Directive on movie production was (–25.32%, 10.00%). By a one-tailed test, the hypothesis that copyright term extension had a positive impact on movie production was rejected with $p = 0.1785$.

Besides measurement error, timing, and sample selection, another possible source of bias was omission of relevant explanatory variables. The obvious possibly omitted variable was other legal changes that took effect at the same time as the Rental Directive. Besides the Rental Directive, there were just two major developments in copyright law

applicable to the European movie industry in the 1990s (Helberger 2000). They were

- European Copyright Term Directive, mentioned above, and
- The WIPO Copyright Treaty, 1996, which created the rights of distribution, rental, and communication to the public.

The WIPO Copyright Treaty was agreed to come into effect three months after thirty member states had deposited instruments of ratification or accession. The Treaty came into effect only in March 2002, following the accession by Gabon. Hence, it is unlikely that the WIPO Copyright Treaty would have affected movie production in the 1990s. Moreover, the content of the Treaty substantially overlapped with the Rental Directive.

By contrast, the European Copyright Term Directive took effect around the same time as the Rental Directive. We estimated the baseline specification including the number of years by which copyright term was extended to comply with the Copyright Term Directive as an additional explanatory variable. As reported in Table 7, column (g), the results were similar to the baseline estimate except that the coefficient of the compliance indicator was not precisely estimated. The 95% confidence interval for the impact of the Rental Directive on movie production was (–26.37%, 8.71%). By a one-tailed test, the hypothesis that copyright term extension had a positive impact on movie production was rejected with $p = 0.140$.

Besides contemporaneous legal changes, another possible omitted variable was government funding. We re-estimated model (2) including government funding as an additional explanatory variable. Owing to limited data, the sample size was reduced by more than a third. As reported in Table 7, column (h), the coefficient of the indicator of compliance with the Rental Directive was positive but not significant. The 95% confidence interval for the impact of the Rental Directive on movie production was (–6.90%, 71.50%). However, we note that the coefficient of GDP per capita was negative, albeit not significant, which does cast some doubt on this estimate.

4.3 Music and Books

As a further check of the robustness of our findings, we tested the impact of the Rental Directive on the production of music CDs and books. Table 8 reports estimates of the baseline specification of model (2).

-- Table 8. Rental Directive: Music and books –

The results were not very precise owing to the limited data on music CDs and books. For music, only the estimate for CD albums (Table 8, column (a)) seemed intuitively reasonable. The coefficients of GDP per capita and population were positive and significant, while the coefficient of the real interest rate was positive, albeit imprecisely estimated. The 95% confidence interval for the impact of the Rental Directive on movie production was (–23.12%, 0.12%). By a one-tailed test, the hypothesis that copyright term extension had a positive impact on music production was rejected with p = 0.017.

For books, only the estimate using IPA data (Table 8, column (c)) seemed intuitively reasonable. The coefficients of GDP per capita and population were positive and significant, while the coefficient of the real interest rate was negative, albeit imprecisely estimated. The 95% confidence interval for the Rental Directive on movie production was (–6.09%, 5.98%).

To the extent that these estimates were reasonable, they confirm our earlier finding that the Rental Directive did not have a significant impact on movie production extended to music and books as well.

5. Concluding Remarks

The extension of copyright term and European Rental Directive were particularly pertinent to the movie industry. Among the various forms of creative work, movies are particularly long-lived (Rapapport 1998), hence movie producers would benefit most from extension of copyright term. The Rental Directive was published specifically to address an inconsistency in copyright law regarding rental rights between European countries and to extend neighboring rights to film producers. Moreover, unlike other copyrightable products such as software, databases, and books, sequential innovation is not important in movies. Hence, if major changes in copyright law had no discernable impact on movie production, it seems the case for copyright law is weak indeed.

For future work, the most obvious direction is to study the production of creative work more deeply, to better understand the intermediate links between copyright law and creative output. How does copyright law affect investment in creative activity? And, how do these investments translate into the quantity and quality of creative work? Perhaps such

a structural analysis might reveal effects of copyright that our reduced form approach (directly measuring the impact on production) did not uncover.

The other direction for future research is to measure the impact of copyright law on the use of existing creative work, and specifically, on the benefit to end-users and also investment in creations that build upon earlier work.

With the results from these studies, it would then be possible to gauge the fundamental trade-off in copyright law between the incentive to create new work and the loss from restricting use of existing work. However, the key challenge in all of these directions for future work would be to acquire the relevant data.

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Copyright Law and the Supply of Creative Work: Evidence from the Movies
Figures and Tables

Figure 1. Nationally and co-produced movies (logarithm)

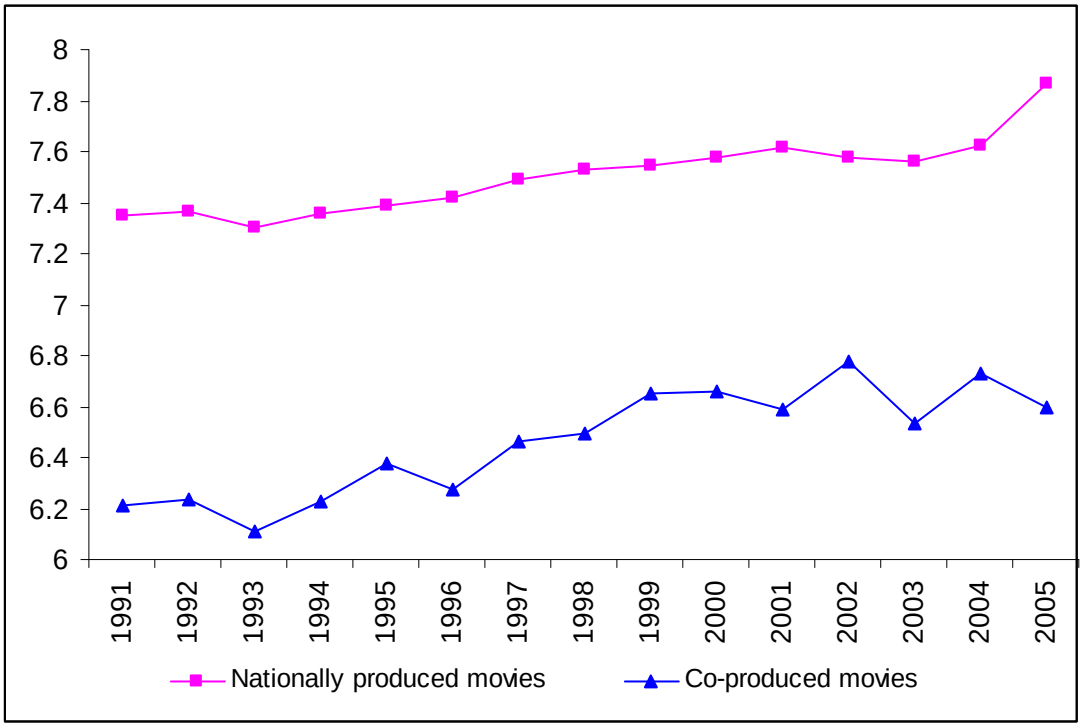
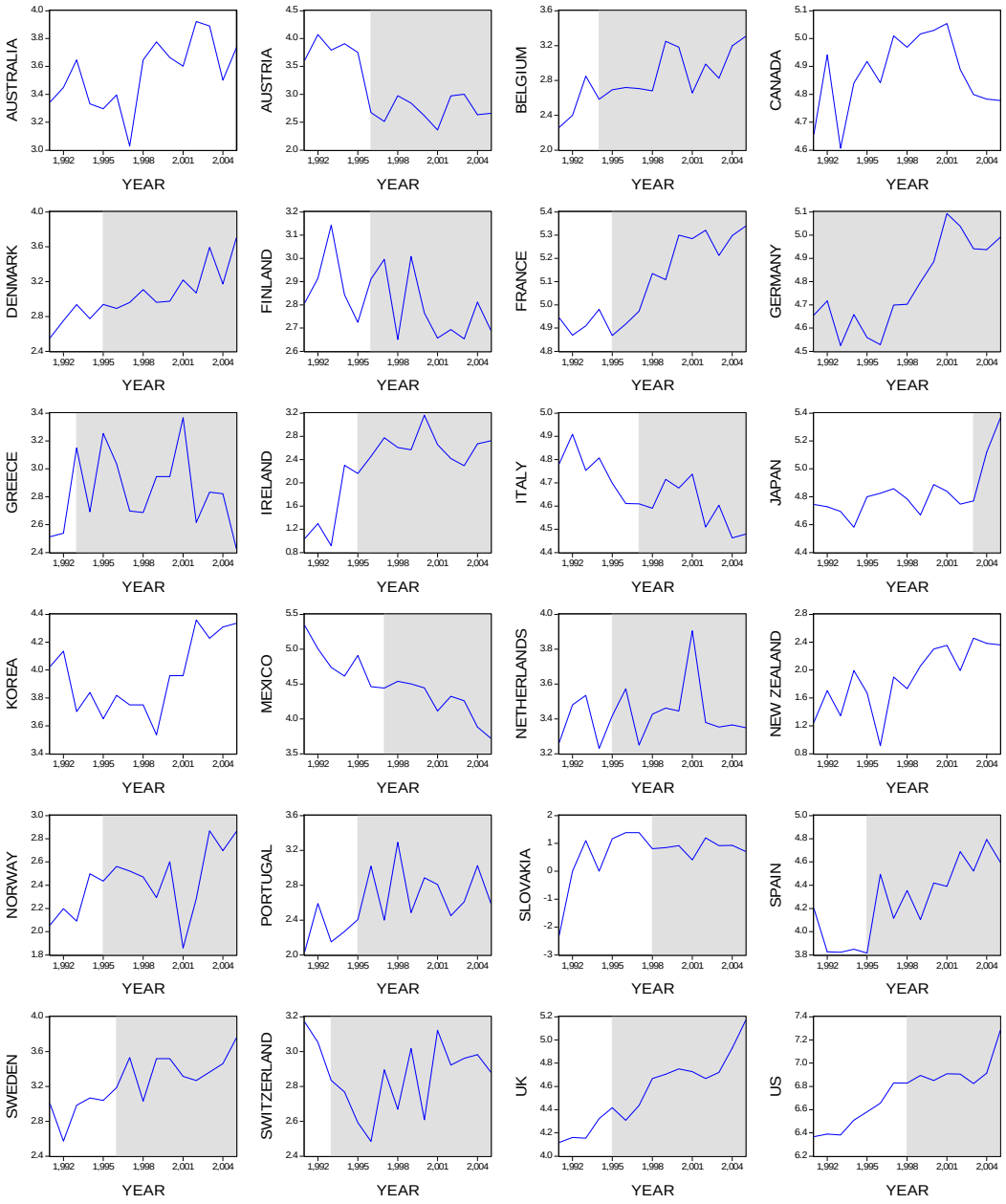


Figure 2. Movie production (logarithm) and copyright term extension



Note: The shaded area represents the period following the effective date of copyright term extension.

Figure 3. Movie production (logarithm) and compliance with Rental Directive

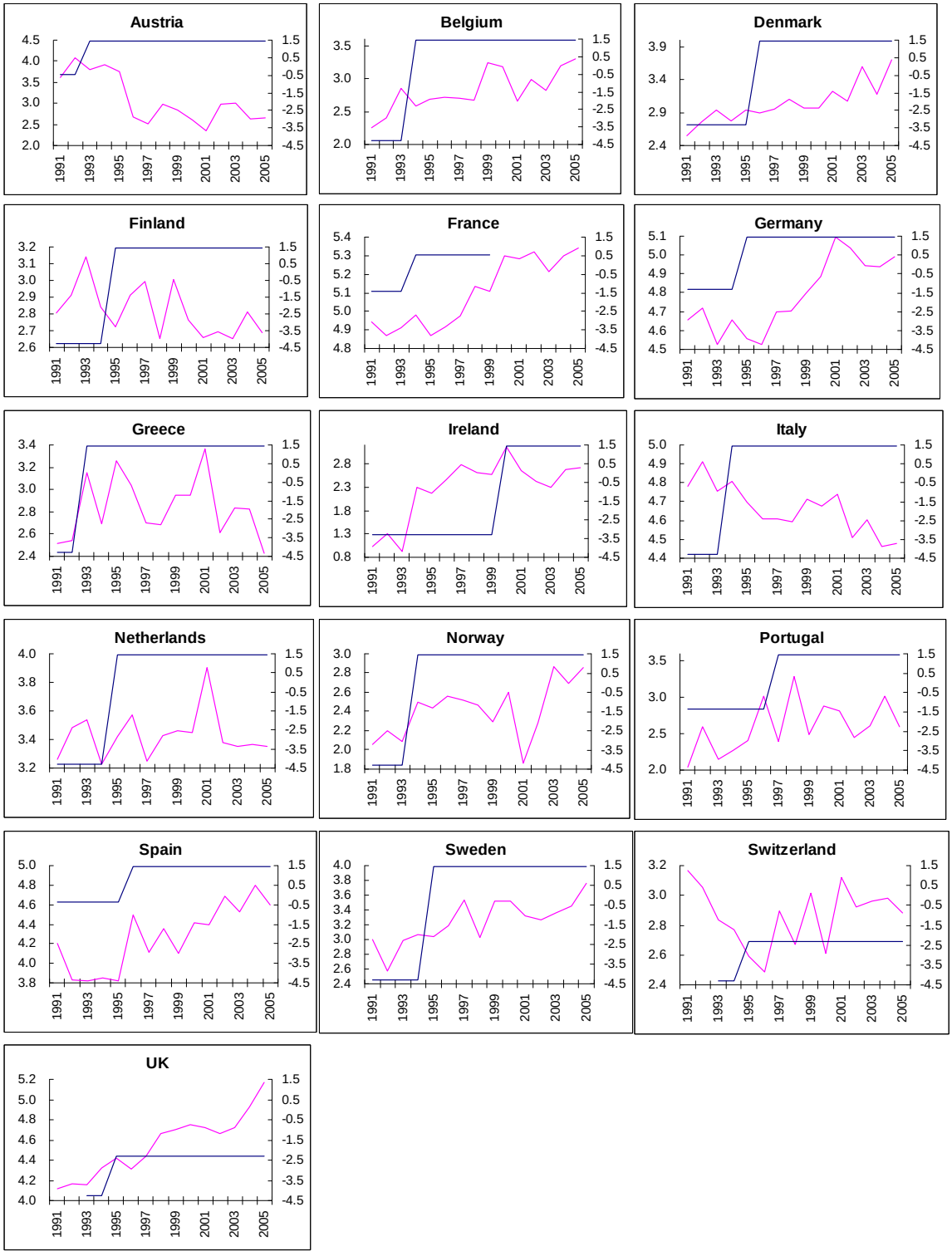


Table 1. Changes in copyright term, 1991-2005

Country	Effective year of term extension[1]	Law
Australia	2005	Copyright Legislation Amendment Act, 2004.
Austria	1996	Federal Law with which the Copyright Act and the 1980 Copyright Act Amendment are amended (BGBI No. 151/1996).
Belgium	1994	Act on Author's Right and Neighboring Rights of 30 June 1994.
Canada	None	n.a.[2]
Czech Republic	2000	Law No. 121/2000 Coll. of 7 April 2000 on Copyright, Rights Related to Copyright and on the Amendment of Certain Laws (Copyright Act).
Denmark	1995	L395 of 13 June 1995.
Finland	1996	Law No. 1654 of 22 December 1995.
France	1995	Intellectual Property Code, Article L123, as amended by Law 97-283 of 27 March 1997.
Germany	None	n.a.[3]
Greece	1993	Copyright Act of 1993.
Hungary	1994	Copyright Act, as amended by Act VII of 1994.
Iceland	1996	Copyright Act (No. 73 of May 29, 1972), as amended by Act No. 145/1996.
Ireland	1995	S.I. No. 158 of 1995.
Italy	1997	Copyright Act, as amended by Legislative Decree No. 654 of 26 May 1997.
Japan	2003	Copyright Law, Article 54, as amended on June 12, 2003.
Luxembourg	1997	Laws of 29 March 1972 and 23 September 1975 on Copyright, as amended on 8 September 1997.
Mexico	(a) 1997 (b) 2003	(a) Federal Law on Copyright of 24 December 1996; (b) Federal Law on Copyright
Netherlands	1995	Copyright Act, as amended by Law 652 of 21 December 1995 (Stb. 1995, 651, 652, and 653).
New Zealand	None	n.a.[4]
Norway	1995	Act No. 2 of May 12, 1961, Relating to Copyright in Literary, Scientific and Artistic Works, etc., as amended by Law No. 27 of 2 June 1995.
Poland	2000	Act on Copyright and Neighboring Rights, as amended on 9 June 2000.
Portugal	1995	D.L. No. 334/97 of 27 November 1997.
Slovakia	1998	Act No. 383/ 1997 of 5 December 1997 - Copyright Act and Act on Changes and Amendments of Customs Act.

South Korea	None	n.a.
Spain	1995	Intellectual Property Act, as amended by Law No. 27 of 11 October 1995.
Sweden	1996	Act on Copyright in Literary and Artistic Works, as amended by Law of 12 April 1996.
Switzerland	1993	Federal Law on Copyright and Neighboring Rights, as amended by the Law of 9 October 1992
Turkey	1995	Law on Artistic and Intellectual Works (No. 5846 of 5 December 1951), as amended in 07/06/1995.
United Kingdom	1995	Copyright Designs and Patents Act, as amended by the Duration of Copyright and Rights in Performances Regulations (S.I. No. 3297 of 1995).
United States	1998	Sonny Bono Copyright Term Extension Act, 1998

Sources: E.C. (undated); Geller (1999); Stewart and Sandison (1989); World Intellectual Property Organization.

Notes:

1. For E.U. and E.E.A. members, if no other information could be found to the contrary, assumed that the country complied with Directive 93/98/CEE.
2. *De minimus* change in 1994: From author's life plus 50 years to author's life plus remainder of the calendar year of death plus 50 years.
3. Copyright term was extended to author's life plus 70 years in 1965.
4. *De minimus* change in 1994: from 50 years after making of the work to 50 years after *later of* making or first publication (Copyright Act of 1994).

Table 2. OECD movie industry: Descriptive statistics

Variable	Unit	Source	Mean	Std. Dev.	Min	Max
Compliance indicator	—	Own research	0.5942	0.4918	0	1
Copyright term extension	Years	Own research	81.61	18.55	50	125
Govt funding	‘000 Euro	KORDA	63225.32	103079.7	381.94	523452.9
Movie production	—	IMDB	107.70	195.37	2.00	1538.00
Movie production excluding co-production	—	IMDB	79.46	169.09	0.10	1391.00
Movie production adjusted for co-production	—	IMDB	91.27	180.37	1.50	1452.37
Movie production	—	FII	67.99	115.03	0.00	625.00
Movie production excluding co-production	—	FII	54.94	99.82	0.00	559.00
Movie production adjusted for co-production	—	FII	60.72	106.68	0.00	589.25
GDP per capita	Thousand USD	GMID	23.11	7.57	3.08	47.79
Population	Thousand	GMID	42753.54	59923.07	3521.00	296410.00
PC per capita	%	GMID	36.79	21.36	0.50	84.00
Internet users per capita	%	GMID	20.87	21.04	0.01	83.02
Real interest rate	%	OECD	3.78	2.17	-3.57	15.06
CD albums	—	IFPI	282.16	250.81	17.00	942.50
CD releases	—	IFPI	14314.42	9230.80	1451	38900
Books	—	IPA	28470.00	26322.90	3441	110155
Books	—	UNESCO	18301.44	13428.15	4985	49123

Table 3. Copyright term extension (Dependent variable: Logarithm of number of new movie releases)

	(a) Baseline	(b) Extension indicator	(c) Nationally produced movies	(d) Film Index Intl	(e) Effective date 1993	(f) Lags on all independent variables	(g) Robust regression	(h) Govt funding
GDP per capita	0.7506*** (0.2874)	0.7592*** (0.2648)	0.3166 (0.3325)	1.4954** (0.6748)	0.8501*** (0.2714)	0.9662*** (0.2979)	0.4698* (0.2404)	-0.8971** (0.4417)
Population	1.3321** (0.5934)	1.3590** (0.5378)	2.4412*** (0.6258)	-3.9865* (2.3902)	1.3362** (0.5458)	0.9364 (0.6226)	0.3491 (0.6630)	0.8864 (0.9255)
Computer ownership	-0.5028*** (0.0749)	-0.5001*** (0.0709)	-0.5381*** (0.0866)	-0.2362 (0.2699)	-0.5146*** (0.0716)	-0.5606*** (0.0758)	-0.5068*** (0.0684)	0.1033 (0.1265)
Internet access	0.0531** (0.0262)	0.0427* (0.0253)	0.0505* (0.0287)	0.1322 (0.0831)	0.0414* (0.0252)	0.0802*** (0.0260)	0.0600** (0.0291)	0.1483*** (0.0556)
Real interest rate	-0.0994 (0.0649)	-0.0939 (0.0641)	-0.1641* (0.0864)	0.0086 (0.0735)	-0.0832 (0.0649)	0.1075* (0.0595)	-0.0796 (0.0513)	-0.0411 (0.0760)
Copyright term extension (years)	-0.1877* (0.0990)		-0.2301** (0.1114)	-0.1441 (0.2780)	0.1263 (0.1183)	-0.1236 (0.0987)	-0.0146 (0.1161)	-1.5332*** (0.1727)
Copyright term extension (indicator)		0.0207 (0.0423)						
Govt funding								0.0094 (0.0247)
Constant	-10.1262 (6.5466)	-11.3260* (6.0199)	-21.18*** (6.9092)	46.5100* (26.8127)	-11.8589* (6.0552)	-6.4971 (6.9234)	0.9849 (7.4667)	4.2062 (10.3556)
R-squared							0.970	
Copyright impact (95% confidence interval)	(–12.76%, 0.52%)	(–6.45%, 10.45%)	(–14.94%, 0.04%)	(–14.48%, 23.94%)	(–3.62%, 12.30%)	(–10.69%, 2.55%)	(–8.31%, 7.33%)	(–52.02%, –28.58%)

One sided test for positive impact	0.0289	0.688	0.0194	0.302	0.857	0.105	0.4501	0
No. of countries	24	24	24	24	24	24	24	17
No. of observations	345	345	345	345	345	321	345	160

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Notes:
All estimates included year dummies.

1. The Wooldridge (2002) test for autocorrelation in panel data could not reject the hypothesis that there was no first-order autocorrelation with Prob($F(1,23) > 1.247$) = 0.2756. The modified Wald test for group-wise heteroskedasticity in fixed effect regression model rejected the hypothesis that there was no heteroskedasticity with Prob($\chi(24) > 606.84$) = 0.000. Accordingly, we used FGLS with heteroskedastic error structure and no cross-sectional correlation.
2. The impact was calculated as $(1+20/50)^{\beta_c}-1$ (where β_c was the coefficient of copyright term extension) on the assumption that copyright term was extended from author's life plus 50 years to authors life plus 70 years.

Table 4. Copyright term extension: Music and books

	(a) CD albums	(b) CD releases	(c) Books (IPA)	(d) Books (UNESCO)
GDP per capita	1.2175*** (0.4500)	2.8087*** (0.7437)	0.0968 (0.3084)	-2.3133*** (0.5533)
Population	5.8365*** (0.5070)	4.8613*** (0.8535)	0.6251 (1.5163)	-32.0672*** (6.8182)
Computer ownership	0.1171** (0.0509)	-0.5610*** (0.1296)	-0.1565* (0.0805)	-0.5496*** (0.1434)
Internet access	0.0745*** (0.0263)	0.1755*** (0.0585)	0.0418 (0.0407)	0.0176 (0.0360)
Real interest rate	-0.1056* (0.0630)	0.2889** (0.1415)	-0.0361 (0.0882)	-0.8714*** (0.1110)
Copyright term extension (years)	-0.0330 (0.0722)	-0.2823** (0.1381)	-0.0358 (0.0938)	-0.7138*** (0.1976)
Constant	0.0000 (0.0000)	-52.0220*** (10.5018)	3.9084 (14.9491)	0.0000 (0.0000)
R-squared	—	—	0.195	—
Copyright impact (95% confidence interval)	(–5.92%, 3.72%)	(–18.39%, 0.27%)	(–7.49%, 5.09%)	(–34.88%, 7.92%)
One sided test for positive impact	0.324	0.0205	0.353	0.00015
No. of observations	61	73	162	25
No. of countries	6	7	24	5

Notes:
All estimates included year dummies.
The Wooldridge tests for autocorrelation in panel data rejected the hypothesis that there was no first-order autocorrelation in specifications (a)-(c) but could not reject this null hypothesis in specification (d). The modified Wald tests for group-wise heteroskedasticity in fixed effect regression model rejected the hypothesis that there was no heteroskedasticity in specifications (a)-(d). Accordingly, for specifications (a) and (b), we used FGLS with heteroskedastic error structure and intra-sectional autocorrelation. For specification (c), we used fixed effects estimation with clustered standard errors (in the FGLS estimate, most coefficients were zero). For specification (d), we used FGLS with heteroskedastic error structure and without intra-sectional autocorrelation or cross-sectional correlation.

Table 5. Compliance with Rental Directive

Country	Article No.								
	1	2	3	4	5	6	7	8	9
	rental	lending	presu-mption	remun-eration	public lending	fixation	reprod-uction	broadcast	distrib-ution
Austria until 1993	1	1	1	0	?	?	0	?	1
Belgium until 1994	0	0	0	0	?	0	0	?	0
Czech 1995 and earlier	?	?	?	?	?	?	?	?	?
1996~1999	0	0	1	0	?	1	?	?	?
2000 and after	1	1	1	1	1	1	1	1	1
Denmark until 1996	1	0	0	0	1	0	0	?	0
Finland until 1995	0	0	0	0	?	?	0	?	0
France until 1994	1	0	1	0	?	?	1	1	0
1994~1999	1	1	1	0	1	1	1	1	1
2000 and after	1	1	1	?	1	1	1	1	1
Germany until 1995	0	1	0	0	?	?	1	1	1
Greece until 1993	0	0	0	0	?	0	0	?	0
Hungary 1993 and earlier	?	?	?	?	?	?	?	?	?
1994~1999	0	0	1	0	?	?	0	?	0
2000 and after	1	1	1	1	1	1	1	1	1
Iceland until 1994	0	0[2]	0	0	?	?	0	0	0
Ireland until 2000	0	0	0	0	?	?	1	1	0
2000 and after	?	?	?	?	?	?	?	?	?
Italy until 1994	0	0	0	0	?	?	0	?	0
Luxembourg until 1997	0	0	0	0	?	?	1	?	1
Netherlands until 1995	0	0	0	0	?	?	0	0	0
Norway until 1994	0	0[5]	0	0	1	?	0	?	0
Poland	?	?	?	?	?	?	?	?	?

1993 and earlier									
1994 and after	1	1	1	1	?	1	1	1	1
Portugal until 1997	1	1	0	0	?	?	1	1	0
Spain until 1996	1	1	0	0	?	?	1	1	1
Sweden until 1995	0	0	0	0	1	?	0	?	0
Switzerland[4] 1992 and earlier	?	?	?	?	?	?	?	?	?
1993~1994	0	0	0	0	?	?	0	?	0
1995 and after	0	0	0	0	?	?	1	?	1
U.K. until 1996	0	1	0	0	?	?	0	1	0

Sources: Reinbothe and von Lewinksi (1993), European Commission (undated), Geller (1999), national copyright laws.

Notes:

1. For all EU members, deemed to comply fully after date of legislation, unless otherwise specified, e.g., France with regard to remuneration right after 1994 and Ireland generally after 2000.
2. Law deemed to comply if required change is "clarified" or "make clear".
3. Reproduction right deemed not to comply if excludes indirect reproduction.
4. Switzerland did not accede to EEA Treaty.
5. Assumed same as Sweden (Nordic system).

Table 6. Indicators of compliance with Directive: Correlations

	rental	lending	presumption	remuneration	reproduction	distribution
rental	1					
lending	0.8757	1				
presumption	0.8477	0.7866	1			
remuneration	0.8224	0.8224	0.8479	1		
reproduction	0.641	0.641	0.5484	0.6468	1	
distribution	0.7197	0.7853	0.6955	0.7536	0.7815	1

Table 7. Rental Directive (Dependent variable: Logarithm of number of new movie releases)

	(a) Baseline[1]	(b Nationally produced movies	(c) Sum of compliance indicators	(d) Effective date 1992	(e) FGLS: Lags on all independent variables	(f) Robust regression	(g) Other laws	(h) Govt funding
GDP per capita	1.2518*** (0.4168)	1.2420** (0.5030)	1.2567*** (0.4175)	1.0548** (0.4162)	1.4943*** (0.4419)	0.7588* (0.3912)	0.8763* (0.4687)	-0.6509 (0.6922)
Population	3.4466*** (0.5790)	4.0311*** (0.7289)	3.4440*** (0.5792)	3.1658*** (0.5777)	3.5094***(0.6993)	2.1103** (0.9403)	4.3694*** (0.8058)	2.5728*** (0.9884)
Computer ownership	-0.1544 (0.0949)	-0.0423 (0.1207)	-0.1561 (0.0950)	-0.1516 (0.0991)	-0.1657 (0.1103)	-0.3822*** (0.1252)	-0.0695 (0.1254)	-0.3661* (0.1973)
Internet access	0.0982*** (0.0348)	0.1070** (0.0423)	0.0988*** (0.0348)	0.1202*** (0.0349)	0.1267*** (0.0340)	0.1104*** (0.0389)	0.1334*** (0.0367)	0.0539 (0.0581)
Real interest rate	0.0729 (0.1345)	0.1078 (0.1665)	0.0735 (0.1346)	0.0636 (0.1368)	0.6870*** (0.1296)	0.1857 (0.1484)	-0.0084 (0.1516)	-0.1536 (0.1642)
Compliance indicator	-0.0232* (0.0126)	-0.0250 (0.0158)	-0.0219* (0.0120)	0.0322 (0.0218)	-0.0198 (0.0132)	-0.0139 (0.0151)	-0.0162 (0.0150)	0.0491 (0.0320)
Copyright term extension (years)	–	–	–	–	–	–	-0.4963*** (0.1387)	
Govt funding	–	–	–	–	–	–	–	0.0285 (0.0274)
Constant	-37.57*** (7.0272)	-44.74*** (8.7481)	-37.45** (7.0192)	-33.64*** (6.9801)	-40.96*** (8.4274)	-20.71** (10.4234)	-44.70*** (9.0184)	-21.07* (11.4060)
Impact of compliance (95% confidence interval)[2]	(–27.02%, 2.22%)	(–31.84%, 5.24%)	(–26.90%, 2.30%)	(–5.87%, 46.27%)	(–26.07%, 4.67%)	(–25.32%, 10.00%)	(–26.37%, 8.71%)	(–6.90%, 71.50%)
R-squared	–	–	–	–	–	0.949	–	–
One sided test for positive impact	0.0328	0.0569	0.0336	0.930	0.0671	0.1785	0.140	0.938
No. of observations	223	223	223	223	208	223	223	149

No. of countries	16	16	16	16	16	16	16	16

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: All fixed effects estimates reported with robust standard errors clustered by country.
All estimates included year dummies

1. The Wooldridge test for autocorrelation in panel data could not reject the hypothesis of no first-order autocorrelation with F(1,15)=0.466, Prob>F=0.5053. The modified Wald test for group-wise heteroskedasticity in fixed effect regression model rejected the hypothesis that of no heteroskedasticity with $\chi(24)=1675.51$, Prob> χ=0.000.
2. The impact of increasing from zero to 100% compliance was calculated as $\exp(\beta_c * \Delta) - 1$(where β_c was the coefficient of Copyright term extension, and Δ was the difference between the minimum and maximum values of the compliance indicator, corresponding to zero and 100% compliance respectively).

Table 8. Rental Directive: Music and books

	(a) CD albums	(b) CD releases	(c) Books (IPA)	(d) Books (UNESCO)
GDP per capita	3.9066*** (0.9325)	-1.6902 (1.1221)	0.4427* (0.2533)	-2.4993*** (0.6927)
Population	6.4114*** (0.4298)	2.9534*** (1.0166)	1.3156** (0.6093)	-21.8557*** (6.9144)
Computer ownership	0.1502 (0.1328)	-0.2360 (0.1629)	-0.1896** (0.0787)	-0.5744*** (0.1676)
Internet access	0.0924** (0.0449)	0.0403 (0.0970)	-0.0125 (0.0180)	0.0605* (0.0342)
Real interest rate	0.0381 (0.0900)	0.2724* (0.1431)	-0.0336 (0.0763)	-0.7809*** (0.1344)
Compliance indicator	-0.0214** (0.0101)	-0.0127 (0.0172)	-0.0001 (0.0053)	-0.0054 (0.0105)
Constant	0.0000 (0.0000)	-19.3890 (13.5193)	-4.5225 (6.9637)	0.0000 (0.0000)
Impact of compliance (95% confidence interval)	-23.12%~ 0.12%	-27.17%~ 13.21%	-6.09%~ 5.98%	-15.13%~ 9.09%
R-square	—	—	—	—
One sided test for positive impact	0.0170	0.230	0.493	0.305
No. of observations	33	45	117	25
No. of countries	4	5	16	5

Notes:
All estimates included year dummies. The Wooldridge tests for autocorrelation in panel data rejected the hypothesis that there was no first-order autocorrelation in specifications (b) and (c) but could not reject this null hypothesis in specification (a) and (d). The modified Wald tests for group-wise heteroskedasticity in fixed effect regression model rejected the hypothesis that there was no heteroskedasticity in specifications (a)-(d). Accordingly, in specification (a) and (d), we used FGLS with heteroskedastic error structure and without intra-sectional autocorrelation, while in specifications (b) and (c), we used FGLS with heteroskedastic error structure and intra-sectional autocorrelation.