Copyright Law, Movie Production, and Video Pricing: the European Rental Directive

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Abstract

In November 1992, the European Economic Community issued Directive 92/100/EEC (the "Rental Directive") to harmonize copyright laws with regard to rights of rental and lending, and the neighboring rights of performers, music and film producers, and broadcasters. Member countries of the European Economic Area were required to comply with the Directive with effect from July 1994.

We studied the impact of the Rental Directive on the production of movies in 17 European countries during the period 1993-2005.

We found that the Rental Directive was associated with an increase in movie production ranging between 10.35% (±6.50%) and 16.81% (±12.71%). Importantly, the increase was higher in countries where piracy was lower. These findings were robust to various specifications, including the measure of compliance with the Rental Directive and the measure of piracy, changes in government funding, other significant changes in copyright law, and exclusion of a possible outlier country.

The Rental Directive enabled movie producers to directly discriminate between video tapes for sale vis-à-vis rental. It was associated with retail rental revenues being 5.81% higher and retail sale revenues being 8.32% higher.

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1. Introduction

Generally, copyright law 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. [1]

There is no disagreement about the directions of these two considerations (Plant 1934; Nordhaus 1969; Gallini and Scotchmer 2002). However, debate on the trade-off has been controversial. Some scholars argue that the scope and term of copyright are excessive (Lessig 2001; Boldrin and Levine 2002; Quah 2002). Others argue in favor of more protection (Landes and Posner 1989; Miller 1995).

The controversies continue to rage in part because there has been very little systematic empirical evidence on either the long-term impact of copyright on the creation of new work or the short-term impact on the use and re-use of existing work. "Perhaps the most pressing area in which the economics of copyright is lacking is in serious empirical studies" (Watt 2004).

In this paper, we study the impact of European Economic Community (EEC) Directive 92/100/EEC, the so-called "Rental Directive", on production of movies and pricing of videos. This Directive was part of the EEC's effort to establish a single European market. The Directive aimed to harmonize copyright laws in the member countries with regard to rights of rental and lending, and the neighboring rights of performers, music and film producers, and broadcasters with effect from July 1994.[2]

Prior to the Directive, copyright laws in the member countries varied in their treatment of rental and lending rights, and the various neighboring rights. We investigated the impact of the Rental Directive on the production of movies in 17 European countries during the period 1993-2005. We found that, on average, revision of national laws to

[1] An alternative is to replace intellectual property rights with a system of rewards for inventors and creators (Shavell and van Ypersele 2001).

[2] In the civil law tradition, authors have copyright, while performers, music producers and broadcasters have "neighboring rights". The common law tradition does not make such a distinction.

comply with the Directive was associated with an increase in movie production ranging between 10.35% (±6.50%) and 16.81% (±12.71%). Importantly, the increase in production was higher in countries with lower rates of piracy.

These findings were robust to exclusion of a possible outlier country and various specifications, including an alternative measure of compliance with the Rental Directive and an alternative measure of piracy, other contemporaneous changes in copyright law, and changes in government funding.

The Rental Directive allowed movie studios to directly discriminate in the sale of video tapes to retailers between those for sale vis-à-vis rental to the end-consumer. Indeed, we found that compliance with the Directive was associated with 17.34% (±4.20%) higher rental rates and 5.39% (±5.34%) lower sell-through prices. Overall, rental and sale revenues were 5.81% and 8.32% higher respectively.

Our findings confirm that changes in the depth and scope of copyright law did have economically significant effects on the production and pricing of at least one category of creative work – movies.

2. Previous Research

Surprisingly, despite persistent controversy, there has been little empirical study of the impact of copyright law on the production of creative work.

In 1998, the United States followed and passed the Sonny Bono Copyright Term Extension Act (CTEA). This extended the term of copyright from author's life plus 50 years to author's life plus 70 years. The CTEA was found to have had positive but insignificant effects on U.S. movie production (Hui and Png 2002), and U.S. copyright registrations (Landes and Posner 2003). However, both studies were confined to just one time series, and hence the statistical tests would have had limited power.

Reynolds (2003) found that the numbers of movies submitted by various countries to the Cannes Film Festival between 1965-2002 were positively and significantly related to his index of copyright law in some specifications. However, submissions were positively, but not significantly, related to copyright term.[3]

[3] 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

Baker and Cunningham (2005) provided the some of 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.

The U.S. CTEA followed European Directive 93/98/CEE to harmonize the term of copyright to author's life plus 70 years with effect from July 1, 1995. Various other countries followed. Using a panel of 23 OECD member countries between 1991-2005, Png and Wang (2007) found that copyright term extension was associated with an increase in movie production ranging between 5.45% (±4.88%) and 7.02% (±4.37%).

Besides the contributions of Baker and Cunningham (2005) and Png and Wang (2007), the impact of copyright protection generally on the incentive to create new work continues to be an open question.

Empirical research into impact of copyright law on the pricing of copyrighted items is also quite sparse. Liebowitz (1985) observed that, following the widespread adoption of photocopying machines, journal publishers raised subscription rates to libraries relative to rates for individuals. Further, the differential was highest for the most frequently copied journals. By charging discriminatory rates, the publishers could "indirectly appropriate" some of the libraries' benefit from copying.

In a very sophisticated study, Mortimer (2007) estimated the retail demand for rental vis-a-vis sell through videotapes and DVDs. She calculated that direct discrimination would benefit studios and consumers at the expense of retailers in the distribution of DVDs, but not necessarily for videotapes.

3. Context

On November 19, 1992, the European Economic Community (EEC) Council of Ministers 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

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statistics are not valid.

with effect from July 1, 1994.[4] This so-called "Rental Directive" was just one of a series of Directives issued to bring about a single European market. By the European Union Treaty ("Maastricht Treaty"), the EEC became the European Union (EU) with effect from November 1, 1993.

Prior to the issuance of the Rental Directive, copyright law in European member 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.[5] 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.[6]

Also, prior to the Directive, copyright law in European member 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;
- Articles 6-9: (neighboring) rights of fixation, reproduction, broadcasting and communication to the public, and distribution for performers, music and movie producers, and broadcasters.

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[4] 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 name for the rights of creators, such as performers, music and movie producers, and broadcasters, who are not authors.

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

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

Based on the survey by Reinbothe and von Lewinksi (1993), we compiled in Table 1 the compliance of existing national copyright law among members of the European Union and European Economic Area (EEA) with Articles 1, 2, 4, 5, and 6-9 of the Rental Directive. By the European Economic Area Agreement, member-countries Austria, Finland, Sweden, Norway, Iceland, and Liechtenstein committed to harmonize their laws with those of the EU.[7] The EEA Agreement took effect in 1994. Although an EEA member, Switzerland did not accede to the EEA Agreement.

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.[8]

-- Table 1: Compliance with Rental Directive --

Where relevant, Table 1 focuses on the changes from the viewpoint of movie producers. An entry "1" indicates that the national copyright law complied with the corresponding Article of the Rental Directive. Where the national law did not comply with the Directive (as indicated by "0"), the national law had to be revised. As Table 1 shows, the survey of Reinbothe and von Lewinksi (1993) and our own legal research was incomplete.

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. 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. To comply with the Directive, the law should have been effective in 1994. Accordingly, we excluded Ireland from our study.

Following several revisions, the original Rental Directive (92/100/EEC) was superseded by Directive 2006/115/EC, issued on December 12, 2006.[9]

4. Data and Specification

[7] "European Economic Area – Overview", http://ec.europa.eu/external_relations/eea/index.htm [Accessed, August 4, 2007]. Subsequently, in January 1995, Austria, Finland, and Sweden joined the European Union. Switzerland did not accede to the EEA Agreement.

[8] 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).

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

Copyrightable works include books, illustrations, photographs, sound recordings, audio-visual works, and software. Among these, so far as we are aware, audio-visual works is the only category about which there is comprehensive international information over a reasonable period of time. This is available from the Euromonitor's Global Market Information Database (GMID). The GMID provides information about the number of movies produced by country and year. [10]

In this study, we focused on the number of movies produced by country-year. We applied a "difference in differences" strategy, which specified movie production in country *i* and year *t* as

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

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.

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).

Referring to Table 1, 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), page 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 2, the indicators were highly collinear. Rather than omit particular indicators, we applied principal components analysis to generate one composite

[10] Two other sources are the Internet Movie Database ("IMDb"), published by Amazon.com, and the Film Index International, published by the British Film Institute. Information in IMBb is organized by title rather than country of production, and is submitted by industry members and website visitors. Moul and Shugan (2005) and Waterman and Lu (2005) used data from the IMDb. The Film Index International allows query of only one title at a time, and prohibits automated extraction of data.

measure of compliance from the six indicators.[11]

-- Table 2: Correlations in compliance indicators --

Referring to Table 3, for each country and year, we obtained information from various sources about other national characteristics that might possibly affect the demand for movies or cost of movie production, and hence movie production – population, GDP per capita, computer ownership and internet access, real interest rates, and piracy. Among these other variables, to minimize multi-collinearity, all national aggregates other than population were specified on a per capita basis.[12]

-- Table 3: Movies: Descriptive statistics --

An immediate concern was a secular trend in the movie industry towards more national production and away from international co-production, as illustrated by Figure 1. This was possibly a result of harmonization of copyright laws, prior to which a producer might have gained additional rights by co-producing in a foreign country. We disregarded movies involving co-production and focused on national productions.

-- Figure 1: Nationally and co-produced movies –

To provide an overview of the impact of the Rental Directive, Figure 2 illustrates, for each country, movie production and the degree of compliance with the Directive over the period 1993-2005. The graphs suggest a slight increase in movie production over the years. This was correlated with the increase in compliance with the Rental Directive. However, the increase in movie production might be explained by general economic growth or a fall in real interest rates.

-- Figure 2: Movie production (logarithm) and compliance with Rental Directive –

5. Results

We first estimated a very simple specification, regressing movie production on just country indicators using ordinary least squares. We report the results in Table 4, column (a).

-- Table 4: Movie production (Natural logarithm) --

[11] 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.

In the next specification, we included the measure of compliance with the Rental Directive, as well as various demographic and financial characteristics – GDP per capita, population, computer ownership and internet access, real interest rates, and year indicators. Table 4, column (b), reports the results. The coefficients of GDP per capita, population, and real interest rate had the expected signs but were imprecisely estimated.

The coefficient of the compliance indicator was positive and significant. An instructive measure of the impact of the Rental Directive is the effect of average increase in compliance with the Directive. Based on the mean number of movies produced, the increase in movie production associated with compliance was +21.98% (±8.70%).

In the following specification, we included a measure of the enforcement of copyright law. The movie industry has vigorously asserted that: "Film theft has an enormous impact on filmmakers everywhere … jeopardizing the creative process and robbing local economies of the benefits derived from having a healthy film industry" (Motion Picture Association of America (MPAA) 2006). Accordingly, movie production should be lower in countries where piracy is higher.

Besides directly affecting movie production, piracy would also moderate the impact of changes in copyright law to comply with the Rental Directive. Where piracy is higher, changes in copyright law should have a smaller effect on movie production.

Unfortunately, we were unable to procure data on movie piracy from the MPAA or elsewhere. However, we did manage to obtain music CD piracy rates from the International Federation of the Phonographic Industry (IFPI) for some years. Table 4, column (c), reports the results with two additional variables – the music CD piracy rate and the interaction of the measure of compliance with the Rental Directive and piracy rate (both in absolute, not logarithmic form). As expected, the coefficient of piracy was negative. However, it was not statistically significant.

Consistent with prediction, the coefficient of the interaction between the measure of compliance with the Directive and piracy rate was negative and precisely estimated. This result is quite compelling: apart from the incentive effect of copyright law, there seems to be no other reason why changes in copyright law should have smaller effects in countries with higher piracy.

Based on the coefficients of piracy and the interaction variable from specification

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[12] Unless otherwise stated, all variables other than indicators were specified in natural logarithms.

(c) and the mean movie production and piracy rate, we calculated the impact of average increase in compliance with the Rental Directive on movie production to be +16.81% (±8.78%).

A potentially serious issue in difference-in-difference studies is serial correlation. This could result in standard errors being substantially under-estimated (Bertrand et al. 2004). Indeed, by a Wald test (Wooldridge 2002; Drukker 2003), the null hypothesis of no first-order serial correlation was rejected ($F = 19.08$, $\Pr(F > 19.08) = 0.0005$). In addition, by a modified Wald test, the null hypothesis of no heteroscedasticity in the residuals was firmly rejected ($\chi^2 = 100.91$, $\Pr(\chi^2 > 100.91) = 0.0000$). By a Friedman (1937) test, the null hypothesis of no cross-sectional dependence could not be rejected ($\chi^2 = 1.65$, $\Pr(\chi^2 > 1.65) = 1.000$).[13] In all subsequent specifications, we applied various methods to account for serial correlation and heteroscedasticity.

As a baseline for the estimates with adjustment for serial correlation and heteroscedasticity, we re-estimated the specification (c) using fixed-effects. Table 4, column (d), reports the results. Next, as recommended by Bertrand et al. (2004), we used fixed-effects with a robust cluster variance matrix. Table 4, column (e), reports the results. As expected, the estimated standard errors of the coefficients of the Directive and its interaction with piracy were larger than in the baseline. Accordingly, the estimated standard error of the impact of compliance with the Rental Directive on movie production was also larger. The estimated impact was +16.81% (±12.17%).

An alternative way to account for serial correlation and heteroscedasticity is to apply feasible generalized least squares (FGLS). Table 4, column (f), reports the FGLS estimates. The estimated coefficients were quite similar to those in the baseline. The major differences were that the coefficient of GDP per capita was larger, while the coefficient of the interaction between the measure of compliance with the Directive and piracy rate was more negative. Overall, the estimated impact of compliance with the Rental Directive on movie production was +10.35% (±6.50%).

Comparing the fixed effects estimate with robust cluster variance matrix and the FGLS estimate, we considered that neither was obviously preferable to the other. In the

[13] For unbalanced panels, this test uses only the observations available for all cross-sectional units. Thus to conduct the test, we had to exclude France, which resulted in 180 observations. The estimation on the smaller samples provided even more compelling results on the impact of the Rental Directive: +25.63% (±11.63%) as compared with +16.81% (±12.17%) from Table 4,

fixed effects estimate (Table 4, column (e)), the coefficients of the real interest rate and piracy were more precisely estimated. In the FGLS estimate, the coefficient of the interaction between the measure of compliance with the Directive and the piracy rate was more precisely estimated. As the results from the two approaches were very similar, in the following robustness checks, we report only the results from the fixed effects estimator.

6. Robustness

To check the robustness of the results in Table 4, we also did the following. First, we checked whether our results were driven by a possible outlier country. We estimated the baseline specification excluding one country at a time. Figure 3 depicts the results in terms of the estimated impact of compliance with the Rental Directive on movie production and the corresponding confidence interval of plus/minus one standard error. Evidently, the results were most sensitive to the exclusion of Belgium and the Netherlands. Even so, the estimated impact of the Rental Directive was significantly differently from zero, albeit marginally so.

-- Figure 3: Impact of Rental Directive on movie production: Outlier check --

Next, we checked the sensitivity of our results to the measure of compliance. An alternative indicator is 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).

Table 5, column (a), reports the results. Relative to Table 4, column (e), the major difference is that the coefficient of the interaction between the measure of compliance with the Rental Directive (now the sum of six indicators) and piracy rate was more than halved. Since higher piracy had a smaller effect on the response to the Directive, the estimated impact of compliance with the Directive on movie production was larger, specifically +19.31% (±12.13%).

-- Table 5: Robustness --

Another possible source of measurement error was piracy. We used the rate of music CD piracy, which might not perfectly reflect movie piracy and which available only from 1994-98. To check the sensitivity of our results to the measure of piracy, we

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column (d).

re-estimated the baseline model using the rate of business software piracy as reported by the Business Software Alliance in place of music piracy.

Table 5, column (b), reports the results. Relative to Table 4, column (e), the major differences were that the overall fit was much worse (R^2 of 0.1574 as compared with 0.7237) and the coefficient of piracy was positive, albeit not statistically significant. Intuitively, we expected music piracy to be more closely correlated with movie piracy than business software piracy. Both movies and music are consumer goods, which are mainly bought by younger people. By contrast, business software is purchased by both businesses and consumers, and the consumer demand is spread across age groups.

With regard to our policy question, the estimated impact of compliance with the Directive on movie production was +37.84% (±16.72%).

Next, we considered the effect of lags between the commissioning and release of movies. In U.S. movie industry, the time from conception to production of print is at least 18 months (Vogel (2004) pp. 53-55). With regard to our context, the Rental Directive was issued in mid-November 1992, which was 17 months before the required changes in law. To the extent of this advance notice, the national enactment of the Rental Directive would not have had any lagged effect on movie production.

Nevertheless, we estimated the baseline specification with all independent variables lagged by one year. Table 5, column (c), reports the results. Relative to Table 4, column (e), the fit was worse (R^2 of 0.3702 as compared with 0.7237). While the coefficients were not very different, they were much less precisely estimated. Even so, the estimated impact of compliance with the Directive on movie production was quite similar, specifically +14.03% (±11.99%).

Besides measurement error and lags, 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, which extended the term of copyright to essentially the author's life plus 70 years with effect from July 1995,[14] and

[14] Directive 93/98/CEE, *O.J.* No. L 290 of 24 November 1993. There was no extension in Germany

- 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. On theoretical grounds, the impact of the Copyright Term Directive on production of creative work was expected to be minimal since the extension was so far into the future (Akerlof et al. 2002). However, in a sample of OECD member countries, Png and Wang (2007) found that copyright term extension was associated with a significant increase in movie production. Accordingly, we estimated the baseline specification including an indicator of compliance with the Copyright Term Directive as an additional explanatory variable.

Table 5, column (d), reports the results. The estimated coefficients were quite similar to those in the baseline estimate (Table 4, column (e)). The coefficient of the indicator of compliance with the Copyright Term Directive was positive but not precisely estimated. The estimated impact of compliance with the Rental Directive on movie production was +17.30% (±10.72%), which was quite similar to and more precise than that with the baseline estimate.

Besides contemporaneous legal changes, another possible omitted variable was government funding. The EU 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 estimated the baseline specification including government funding as an additional explanatory variable.

Table 5, column (e), reports the results. Owing to the limitations of the data, the

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as its copyright term was already author's life plus 70 years.

number of observations was reduced to 142. Compared with the baseline estimate in Table 4, column (e), the coefficient of piracy was positive and significant, and the coefficient of government funding was negative, and almost significant. The coefficients of the measure of compliance with the Rental Directive and of the interaction between the measure of compliance and the piracy rate were larger in magnitude and more precisely estimated. However, the estimated impact of compliance with the Directive on movie production was +11.91% (±20.74%).

The poor fit and the counter-intuitive estimates of the coefficients of piracy and government funding were possibly the results of the incomplete data on government funding. Consequently, we are skeptical of the estimate including government funding, as reported in Table 5, column (e).

Yet another possible missing variable is that the Rental Directive took effect together with multiple changes in laws and regulations that improved the overall investment climate across the entire economy. Specifically, the European Union harmonized copyright laws as part of its single-market initiative, and Central and East European countries revised their copyright laws in anticipation of joining the European Union. Hence, any increase in movie production might be due to market expansion and removal of barriers to intra-European trade rather than the Rental Directive.

The most relevant data that we could find was from the European Audiovisual Observatory, which reports, for each European country, the numbers of movies exhibited in cinemas that were produced domestically and in other European and the United States. In Figure 4, we depict the number of movies from other European countries. There is no obvious upward trend, which suggests that any increase in movie production was not due to the single European market. This inference was supported by regressions reported in Table 5. In column (a), we report regressions of the numbers of movies produced in other European countries on a time trend. For no country was the time trend positive and significant. In column (b), we report a regression on country and year indicators. None of the year indicators was positive and significant.

-- Figure 4: Market share of movies imported from other EU countries –

Finally, it might be possible that the timing and extent of the changes in copyright law required for compliance with the Rental Directive were influenced by the movie industry. For instance, in countries where movie production was high, the industry would have been relatively powerful, and so, copyright law would have favored the industry. In

such countries, copyright law would be relatively closer to compliance with the Rental Directive. However, this would not itself explain any correlation between the increase in movie production and the change in the compliance indicator with the Rental Directive.

Anyhow, to check this, we regressed the change in the compliance indicator on the initial size of the movie industry, measured by movie production in 1993. The size of the movie industry was not significant (for brevity, the results are not reported here). We also note that all of our regressions included country fixed effects, which could account for endogeneity in the timing and extent of the changes in compliance. Furthermore, we also used political indicators from the World Bank Database of Political Institutions as possible instruments for the compliance indicator. The relevant test suggested that the compliance indicator was not endogenous.[15]

7. Price Discrimination

So far, we have not considered how the European Rental Directive stimulated movie production. Presumably, the Rental Directive raised the profits that movie studios expected from making movies. Videos provide 2.79~22.92%[16] of movie studio revenues. For studios, a major impact of the Directive was to allow them to directly discriminate in the sale of video tapes to retailers between those for sale vis-à-vis rental to the end-consumer.

Video retailers both sold and rented tapes. Prior to the Rental Directive, the copyright laws of the various European countries differed in whether movie studios could control retail rental of video tapes. Indeed, it was Warner's attempt to enforce such controls that triggered the issuance of the Rental Directive. Following revision of national laws to comply with the Rental Directive, direct discrimination between tapes for sale vis-à-vis rental became feasible throughout the EU.

To model the impact of the Rental Directive on retail pricing, we followed Varian (2000) and Mortimer (2007). Suppose that direct discrimination is legal. Consider a monopoly movie studio that produces tapes at a marginal cost of c, and sells the tapes for sell-through and rental at wholesale prices of w_s and w_r respectively. For simplicity, suppose that the video retail industry is perfectly competitive, operates with zero mark-up

[15] The endogeneity test (Wooldridge 2002. pp.118) cannot reject the null hypothesis that there is no endogeneity of the compliance indicator (T=-1.41).
[16] Source: European Audiovisual Observatory Yearbook 2005, Film and Home Video, Vol. 3., T.12.4 amd

on wholesale price, and turns over each rental tape τ times. Since retailers operate with zero mark-up, the retail prices for sale and rental would be w_s and w_r/τ respectively. Let the retail demands for sale and rental tapes be $Q_s(w_s)$ and $Q_s(w_s/\tau)$.

Suppose the studio sets wholesale prices to maximize profit

$$\pi = [w_s - c]Q(w_s) + [w_r - c]Q\left(\frac{w_r}{\tau}\right). \quad (2)$$

The first-order conditions are

$$\frac{d\pi}{dw_s} = [w_s - c]\frac{d}{dw_s}Q(w_s) + Q(w_s), \quad (3)$$

and

$$\frac{d\pi}{dw_r} = [w_r - c]\frac{d}{dw_s}Q\left(\frac{w_r}{\tau}\right) + Q\left(\frac{w_r}{\tau}\right). \quad (4)$$

By contrast, if direct discrimination were not legal, we suppose that the studio would maximize (2) subject to the constraint, $w_s = w_r = w$. Generally, in the unconstrained scenario, (2)-(4), the studio would earn higher profit and set different prices $w_s \neq w_r$, while in the constrained scenario, the studio would earn lower profit and be required to set a single price, w. Accordingly, we expect that compliance with the Rental Directive would be associated with discrete changes in the retail prices and rental rates.

The analysis does not provide any unequivocal prediction as to the direction of change of the prices and rental rates. To the extent that the demand for rental tapes is more price-elastic than the demand for sale tapes, compliance with the Rental Directive would lead to an increase in rental rates and a reduction in sale prices.[17] [18]

T.13.11.

[17] Here, it is important to emphasize the *ceteris paribus* assumption, in particular, that the compliance with the Rental Directive was not contemporaneous with introduction of revenue-sharing contracts to resolve double marginalization between studios and retailers (Varian 2000; Dana and Spier 2001).

[18] Under the first sale doctrine of U.S. copyright law, direct discrimination between tapes for sale vis-à-vis rental is not legal. For a sample of high-grossing U.S. movies released in 2000-01, Mortimer (2007) estimated the retail demand for video-tape sales and rentals. She then calculated the average price and rental rate that would have maximized profit if direct discrimination were legal. For tapes initially priced for rental, direct discrimination would have reduced the rental rate by 12% from \$2.84 to \$2.51, while for tapes initially priced for sell-through, direct discrimination would have reduced the rental by 19% from \$3.04 to \$2.45. Hence, direct discrimination would have resulted in rental rates that would have been 12% or 19% lower than without direct discrimination. The implication of direct discrimination on the retail price of video-tapes was

We collected data on retail prices and rental rates of videos for the same 17 European countries over the period 1993-2005 from Euromonitor's Global Market Information Database (GMID). We should immediately caution that these retail prices and rental rates pertain to all videos, including those originating from the U.S. and other countries. Unfortunately, the available information did not distinguish the country of origin. Hence, our empirical study of pricing would not exactly align with our study of European movie production reported in Sections 4-6 above.

The GMID pricing data was very fragmentary for the early years, and indeed data for 1995 were almost entirely missing. We converted the prices and rental rates at the prevailing exchange rates to European Currency Units (Euros). Table 7 provides summary statistics.

-- Table 7: Videos: Descriptive statistics –

To investigate the impact of the Rental Directive on video pricing, we regressed the natural logarithms of video rental rates, rental volumes, sale prices, and sales volumes on various national characteristics that might possibly affect the demand for video sales and rentals – population, GDP per capita, computer ownership and internet access, piracy, and the measure of compliance with the Rental Directive.

Generally, in all of these estimates, we encountered serial correlation and heteroscedasticity. We addressed these with two alternative estimators – fixed effects with robust cluster covariance matrix and feasible GLS. We preferred the feasible GLS estimators as they tended to provide more precise estimates of the impact of the Rental Directive.

Table 8, columns (a)-(c), reports the impact of compliance with the Rental Directive on video rental rates. Compliance was associated with a 17.34% (±4.20%) increase in rental rates. Table 8, columns (d)-(f), reports the corresponding results for the volume of video rentals. Compliance with the Rental Directive was associated with the volume of video rentals being 11.53% (±8.23%) lower.[19] The reduction in rental volume

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ambiguous because, under the strategy of pricing initially for rental, the retail price would be first set high, and then, when the rental market had been saturated, the retail price would be reduced.

[19] The 17.34% (±4.20%) increase in rental rates coupled with the 11.53% (±8.23%) reduction in rental volume were the outcome of separating the combined demand for rentals and sell-through into separate demand curves. Accordingly, it should not be inferred from the estimated changes that the rental demand was inelastic.

was consistent with rental rates being higher. Taking account of both the increase in rental rate and the decline in rental volume, the Rental Directive was associated with an average increase in revenue of about [17.34% –11.53%] = 5.81%. Using the mean rental rate and volume from Table 7, this amounted to 5.81% x 2.88 x 29.1 = €4.87 million annually per country.[20]

-- Table 8: Video rentals --

Table 9 reports results for selling prices of video tapes and the corresponding sales volumes. Compliance with the Rental Directive was associated with a 5.39% (±5.34%) reduction in selling price and a 13.71% (±8.30%) increase in sales volume. The increase in sales volume was consistent with prices being lower.[21] Taking account of both the reduction in selling prices and the increase in volumes, the Rental Directive was associated with an average increase in revenue of about [13.71% – 5.39%] = 8.32%. Using the mean rental rate and volume from Table 7, this amounted to 8.32% x 11.9 x 11.8 = €11.68 million per country annually.[22]

-- Table 9: Video sales –

We have estimated of the impact of the Rental Directive on movie studio *revenues*. Ideally, we would have liked to estimate the impact of the Directive on the *profits* of the movie studios in each of the various European countries. There are several important differences between what we could estimate and what we would have liked to estimate.

Our revenue numbers over-estimated the change in profit for two reasons. Obviously, they ignored the cost of producing the additional sell-through tapes. Moreover, they included revenues from all video-tapes sold in the various European countries, whether produced within Europe or elsewhere.

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[20] The corresponding increase in revenue using the fixed-effects estimates was [24.86% – 19.49%] x 2.88 x 29.1 = €4.50 million per country annually.

[21] Our model of video pricing, (2)-(4), did not consider that, if movie studios could not directly price discriminate, they might discriminate indirectly by pricing tapes high, targeting the rental demand, and then, after some months, cutting the price low for sell-through (Mortimer 2007). The Rental Directive allowed studios to set two prices – one for rental and another for sell-through. Hence, the impact on the selling price would be two-fold: lower to the extent that the price need not be balanced against the price for rental tapes, but possibly higher to the extent that studios would no longer cut prices for sell-through after some months.

[22] The corresponding increase in revenue using the fixed-effects estimates was [9.22% – 7.70%] x 11.9 x 11.8 = €2.13 million per country annually.

However, our revenue numbers under-estimated the change in profit due to the Rental Directive for two reasons. They did not capture increases in movie studio profits arising from other aspects of the Rental Directive, for instance, the neighbouring rights which might have yielded new revenue streams such as pay-TV. Further, the Rental Directive was just one element of the EU's general program to reduce trade barriers within Europe. The increase in studio profits due to the Rental Directive might have been masked by a contemporaneous increase in parallel imports, which diminished studio profits.

8. Concluding Remarks

We investigated the impact of the European Rental Directive on the production of movies in 17 countries during the period 1993-2005. We found that, on average, revision of national laws to comply with the Directive was associated with an increase in movie production ranging between 10.35% (±6.50%) and 16.81% (±12.71%). Importantly, the increase in production was higher in countries with lower rates of piracy.

These findings were robust to exclusion of a possible outlier country, and various specifications, including an alternative measure of compliance with the Rental Directive and an alternative measure of piracy, other contemporaneous changes in copyright law, and changes in government funding.

These findings were bolstered by a study of the impact of the Directive on video sales. We found that on average, revision of national laws to comply with the Directive was associated with a 5.81% increase in revenue from video rentals and an 8.32% increase in revenue from video sales.

These results are significant as there have been very few systematic empirical analyses to show any impact from changes in copyright law on the production of creative work (Png 2006). 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 on two margins – the number of titles and the investment in each title? And, how do these investments translate into the quantity and quality of creative output such as movies, books, and recorded music?

The other direction for future work is to measure the impact of copyright law on the use of existing creative work, and specifically, on the benefit to end-users as well as

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 is to acquire the relevant data.

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Table 1. Compliance with Rental Directive

	Article No.								
	1	2	3	4	5	6	7	8	9
Country	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 1994	0	0	0	0	?	?	1	1	0
1994 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[2]	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[1] 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 1994.
2. Switzerland did not to accede to EEA Treaty.
3. Assumed same as Sweden (Nordic system).
4. Law deemed to comply if required change is "clarified" or "make clear".
5. Reproduction right deemed not to comply if excludes indirect reproduction.

Table 2. Correlations in compliance indicators

	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 3. Movie Production: Descriptive statistics (187 observations from 17 countries)

Variable	Unit	Source	Mean	Max	Min	Std dev
Movie production	—	GMID	44.16	201	6	40.70
Compliance with Rental Directive[1]	—	Table 1	0.65	1.3636	-4.47	1.63
GDP per capita	Thousands USD at PPP	GMID	24.73	41.63	14.28	5.42
Population	'000	GMID	25149.81	82537	4299	25752.95
PC per capita[2]	Per 100 households	GMID	40.86	84	7	19.49
Internet users per capita	%	GMID	25.10	104.08	0.12	20.54
Real long-term interest rate[3]	%	OECD	3.46	8	0.02	1.66
Piracy[4]	%	IFPI	5.68	35.46	0	6.51
Time	—	~	1999.36	2005	1993	3.70

Notes:

1. Considering significance to the movie industry and availability of data, we focused on 6 out of 9 articles in the Rental Directive: rental, lending, presumption, remuneration, reproduction and distribution. We constructed their principal component as the indicator of compliance. The correlation between the principal component and the sum of the compliance indicators for these six articles was 0.87.
2. Data on personal computers per capita for Iceland and Luxemburg were not available for all years.
3. Real long-term interest rate was calculated as long-term interest rate less year-to-year change in the consumer price index. The real interest rates of the Czech Republic, Greece, Hungary, Iceland, and Poland were not available for some years.
4. Piracy rates on CD for Luxemburg were not available for all years.

Table 4. Movie Production (Dependent variable: Number of movies produced)[1]

Specification	a	b	c	d	e	f
	Country indicators only[2]	Demographic variables	Piracy[3]	Fixed effects	Fixed effect estimation with robust cluster variance matrix[4]	FGLS Cross-sectional time-series Panels[5]
GDP per cap	—	1.0379 (0.7092)	1.185 (0.7262)	1.1855 (0.7262)	1.1855 (0.9006)	1.6042*** (0.5345)
Population	—	0.9013 (1.3229)	0.4896 (1.3215)	0.4896 (1.3215)	0.4896 (1.165)	1.5094 (1.3216)
PC per cap	—	-0.244 (0.1543)	-0.265 (0.169)	-0.265 (0.169)	-0.265 (0.1792)	-0.1777 (0.1288)
Internet users per cap	—	0.0717 (0.0523)	0.0924* (0.0523)	0.0924* (0.0523)	0.0924 (0.057)	0.0959** (0.0417)
Real interest rate	—	-0.0573 (0.0439)	-0.0571 (0.0434)	-0.0571 (0.0434)	-0.0571* (0.0285)	-0.0493 (0.0308)
Piracy (music CD)	—	—	-0.0119 (0.0117)	-0.0119 (0.0117)	-0.0119* (0.0063)	-0.0086 (0.0124)
Rental Directive	—	0.0462** (0.0194)	0.0361* (0.0196)	0.0361* (0.0196)	0.0361 (0.0267)	0.0229 (0.0146)
Rental Directive * Piracy	—	—	-0.0047* (0.0026)	-0.0047* (0.0026)	-0.0047 (0.0033)	-0.0063**** (0.0018)
Constant	4.471**** (0.08)	-7.8196 (15.7232)	-3.4699 (15.7055)	-3.6606 (13.4851)	-3.6606 (12.8965)	-16.4327 (15.4176)
Country indicators	Included	Included	Included	—	—	Included
Year indicators	—	Included	Included	Included	Included	Included
Adj. R^2	0.8726	0.9228	0.9249	—	—	—
R^2: within	—	—	—	0.4799	0.4799	—
R^2: between	—	—	—	0.7398	0.7398	—
R^2: overall	—	—	—	0.7237	0.7237	—
# of obs.	187	187	187	187	187	187
Impact of Rental Dir.	—	21.98%	16.81%	16.81%	16.81%	10.35%
Impact std. dev.	—	8.70%	8.78%	8.78%	12.17%	6.50%

**** significant at 99.9%; *** significant at 99%; ** significant at 95%; * significant at 90%.

Notes:

1. Iceland, Ireland, Luxemburg, and Poland were excluded because of data being unavailable for more than half of the studied period. Some country-years were excluded because of missing data on real interest rates (Greece and Portugal), and on compliance with the Rental Directive (Czech Republic, France, Greece and Switzerland).
2. Germany was omitted from the country fixed effects.
3. In the interaction term between the piracy rate and the indicator of Rental Directive, we specified the piracy rate as its difference from the sample mean (Wooldridge (2002, page 194). Hence, the coefficient of Rental Directive indicator was the partial effect of the Rental Directive 92/100 on movie production at the mean piracy rate.
4. As recommended by Bertrand et al. (2004), the estimator for the variance-covariance matrix under OLS was a generalized White-like formula (Huber 1967; White 1980). It allowed for within-panel correlation, relaxing the usual requirement that the observations be independent.

5. This FGLS regression adjusted the variance covariance matrix estimator on the assumption of AR(1) autocorrelation within panels and heteroskedasticity across panels.

Table 5. Robustness (Dependent variable: Number of movies produced; Fixed effect estimation with robust cluster variance matrix)

Specification	(a) Sum of 6 compliance indicators	(b) Software piracy instead of music piracy	(c) Lagged independent variables	(d) Copyright Term Directive	(e) Government funding[1]
GDP per cap	1.4138 (0.9214)	1.2558 (0.9921)	1.6004* (0.9119)	1.0542 (1.0118)	0.8907 (0.9342)
Population	0.6972 (1.184)	0.0816 (1.4094)	-0.3453 (1.017)	0.342 (1.3814)	-1.1499 (1.9808)
PC per cap	-0.261 (0.2031)	-0.3187 (0.2203)	-0.5117** (0.183)	-0.2918 (0.2048)	0.1405 (0.2718)
Internet users per cap	0.0963 (0.0627)	0.0483 (0.0591)	0.1142* (0.054)	0.0948 (0.0586)	-0.0018 (0.0727)
Real interest rate	-0.0527* (0.0279)	-0.0654* (0.034)	-0.1309 (0.0888)	-0.0569* (0.0272)	-0.0254 (0.0662)
Piracy	-0.0105 (0.0076)	0.4909 (0.3117)	-0.0117 (0.0074)	-0.0127* (0.0071)	0.0364*** (0.0099)
Rental Directive	0.041 (0.0266)	0.0746* (0.0359)	0.0305 (0.0263)	0.0371 (0.0237)	0.0262 (0.0438)
Rental Directive *Piracy	-0.0018 (0.0012)	-0.0021 (0.0023)	-0.0047 (0.0027)	-0.0054* (0.003)	-0.0104* (0.0058)
Government funding	—	—	—	—	-0.0641 (0.0487)
Copyright Term Directive	—	—	—	0.2116 (0.1705)	—
Constant	-6.3256 (13.1383)	-1.9777 (15.1932)	4.0582 (11.3548)	-1.7905 (15.2697)	11.939 (19.8844)
Year indicators	Included	Included	Included	Included	Included
R^2: within	0.4779	0.4716	0.5044	0.496	0.4199
R^2: between	0.7593	0.139	0.5826	0.6817	0.7821
R^2: overall	0.7501	0.1574	0.3702	0.639	0.6946
# of observations	187	187	183	187	142
Impact of Rental Directive	19.31%	37.84%	14.03%	17.30%	11.91%
Impact std.	12.13%	16.72%	11.99%	10.72%	20.74%

Note: We collected data on national funding from Database on public funding for the film and audiovisual sector in Europe (KORDA) and European Audiovisual Observatory (1999). Data for 2005 was unavailable.

Table 6. Market share of movies imported from other EU countries (OLS with heteroskedastic disturbances across panels)[1]

Specification	(a) Time trend	(b) Year indicators
Czech	-11.9747 (1.4414)****	-12.1806 (1.4319)****
Denmark	-11.6980 (1.4904)****	-11.8078 (1.5125)****
Germany	-14.8747 (1.3242)	-15.1465 (1.4386)
Finland	-14.3982 (2.0400)****	-14.3560 (1.8399)****
France	-14.3580 (1.3001)****	-14.4678 (1.3550)****
Hungary	-13.6880 (1.9464)****	-13.7978 (1.8759)****
Italy	-8.5110 (1.6135)****	-8.6208 (1.3919)****
Netherlands	-12.8846 (1.6454)****	-12.8851 (1.4918)****
Spain	-9.5680 (1.6259)****	-9.6778 (1.5067)****
Switzerland	-11.4846 (1.5185)****	-11.4851 (1.5792)****
Sweden	1.9620 (2.4672)	1.8522 (2.2694)
UK	-20.4380 (1.3879)****	-20.5478 (1.3831)****
Time trend	0.0555 (0.1235)	—
Year 1995	—	-0.4466 (3.6836)
Year 1996	—	-0.2599 (3.6709)
Year 1997	—	1.5126 (3.6732)
Year 1998	—	-1.3699 (3.6549)
Year 1999	—	3.0872 (3.6549)
Year 2000	—	-0.4506 (3.6549)
Year 2001	—	3.9632 (3.6709)
Year 2002	—	2.1742 (3.7712)
Year 2003	—	-0.9914 (3.7588)

Year 2004	—	-0.5404 (3.7792)
Constant	21.9863 (1.3147)****	21.9 (3.3605)****
Adj. R^2	0.7169	0.7741
# of observations	133	133

Notes:

1. Norway and Portugal were excluded from the estimation due to too few observations. The Breusch-Pagan / Cook-Weisberg test for heteroskedasticity rejected the null hypothesis of constant variance (χ^2=28). The Wooldridge test for autocorrelation in panel data cannot reject the null hypothesis of no first-order autocorrelation (F=0.785). Using OLS with adjustment on the standard errors for cross-panel heteroscedasticity, none of the coefficients of the time trend or the year dummy variables were significantly positive at 90% confidence level.

Table 7. Video pricing: Descriptive statistics (165 observations from 17 countries, 1993-2005[1])

Variable	Unit	Source	Mean	Max	Min	Std dev
Video rental rate[2]	ECU (Euro)	GMID	2.8829	5.8711	0.4897	1.0744
Video rental volume	Million units per year	GMID	29.1036	204.4000	0.2000	39.3263
Video sale price	ECU (Euro)	GMID	11.9246	25.0460	3.9167	3.4515
Video sales volume	Million units per year	GMID	11.8606	99.8000	0.2000	19.7562

Notes:

1. Data for 1995 are mostly missing.
2. Exchange rates followed Eurostat.

Table 8. Video pricing[1]

	Rental rate[2]			Rental volume[5]		
	Fixed effect estimator[3]	Fixed effect estimator[3]	FGLS[4]	Fixed effect estimator[3]	Fixed effect estimator[3]	FGLS[4]
GDP per cap	0.4186 (0.647)	0.799 (0.5103)	1.1581**** (0.2891)	6.9062** (3.1273)	5.749* (3.1775)	5.7723**** (0.9692)
Population	-0.7774 (1.1537)	-0.468 (1.1983)	-0.3275 (0.6579)	3.9579 (2.9009)	3.0163 (2.8732)	6.155**** (1.336)
PC per cap	0.1085 (0.0823)	-0.0121 (0.107)	0.0709 (0.071)	-0.1691 (0.6009)	0.1979 (0.5831)	0.1133 (0.1919)
Internet users per cap	0.0283 (0.0767)	0.0353 (0.0797)	-0.0127 (0.0287)	0.2682* (0.1524)	0.2469** (0.1068)	0.289**** (0.0637)
Piracy	—	-0.0245** (0.0108)	-0.0139**** (0.0044)	—	0.0745** (0.0317)	0.0377* (0.0209)
Rental Directive	0.0579** (0.0244)	0.0516** (0.0234)	0.0372**** (0.0096)	-0.0695 (0.0602)	-0.0504 (0.0519)	-0.0285 (0.0184)
Rental Directive * Piracy	—	0.0023** (0.001)	0.0017* (0.001)	—	-0.0071* (0.0038)	-0.0041* (0.0021)
Constant	7.0108 (11.3081)	3.3288 (11.4276)	0.9298 (7.6292)	-53.3491 (31.5331)	-42.1442 (31.3858)	-81.3144**** (16.0355)
Country indicators	—	—	Included	—	—	Included
Year indicators	Included	Included	Included	Included	Included	Included
R^2: within	0.4773	0.5149	—	0.8797	0.8928	—
R^2: between	0.0124	0.0751	—	0.6524	0.647	—
R^2: overall	0.0495	0.1419	—	0.521	0.5512	—
# of Obs.	165	165	165	165	165	165
Impact of Rental Dir.	28.28%	24.86%	17.34%	-25.84%	-19.49%	-11.53%
Impact std. dev.	11.05%	10.57%	4.20%	29.56%	25.00%	8.23%

Notes:

1. All variables except indicators in natural logarithms
2. The Wooldridge test for autocorrelation in panel data rejected the null hypothesis of no first-order autocorrelation (F = 56.02, Pr(F > 56.02) = 0.0000). There was also strong evidence of heteroskedasticity in the residuals ($\chi 2$ =1257.40, Pr($\chi 2$ > 1257.40) = 0.0000).
3. Robust cluster variance matrix.
4. Cross-sectional time-series panels.
5. The Wooldridge test for autocorrelation in panel data rejected the null hypothesis of no first-order autocorrelation (F = 42.14， Pr(F > 42.14) = 0.0000). There was also strong evidence of heteroskedasticity in the residuals ($\chi 2$ = 1511.66, Pr($\chi 2$ > 1511.66) = 0.0000).

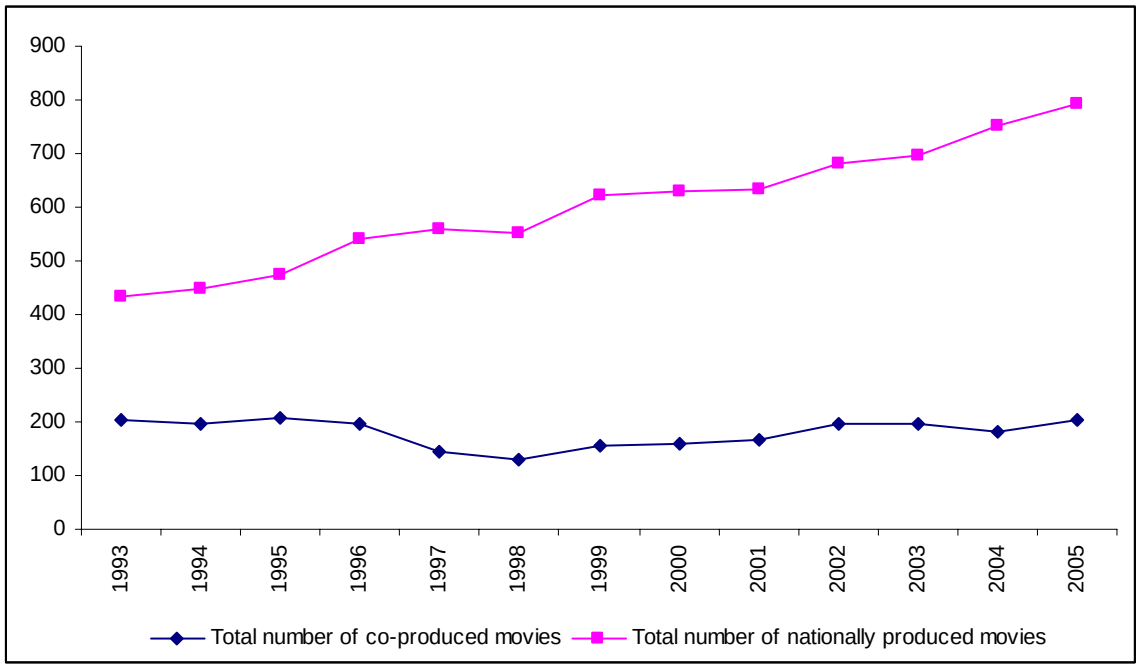
Table 9. Video sales[1]

	Sales price[2]			Sales volume[5]		
	Fixed effect estimator[3]	Fixed effect estimator[3]	FGLS[4]	Fixed effect estimator[3]	Fixed effect estimator[3]	FGLS[4]
GDP per cap	1.3657 (0.8081)	0.8102 (0.707)	0.5267 (0.3485)	2.572 (1.7274)	3.041 (1.8631)	4.0335**** (0.638)
Population	-0.0131 (1.8349)	-0.0133 (1.8115)	-1.4644* (0.8526)	-8.1025 (5.569)	-8.0268 (5.5608)	-6.4894*** (2.288)
PC per cap	0.0233 (0.1776)	0.1448 (0.1267)	0.1396 (0.0907)	0.622* (0.3252)	0.5103 (0.3521)	0.1122 (0.1432)
Internet users per cap	0.0747 (0.0523)	0.0393 (0.0398)	0.0216 (0.0299)	-0.2906** (0.1137)	-0.2649** (0.1195)	-0.1522*** (0.0567)
Piracy		0.0255**** (0.0055)	0.0221** (0.0086)		-0.0233 (0.0181)	-0.0091 (0.0139)
Rental Directive	-0.0086 (0.016)	-0.0186 (0.0214)	-0.0129 (0.0121)	0.0152 (0.0289)	0.0205 (0.0257)	0.0299 (0.0185)
Rental Directive * Piracy		0.0033** (0.0014)	0.0025** (0.0011)		-0.0017 (0.0025)	-0.0008 (0.0016)
Constant	-0.868 (17.8682)	0.2439 (17.7098)	17.3659* (9.8946)	67.9989 (54.2444)	66.3463 (53.8697)	63.3141** (26.5799)
Country indicators	—	—	Included	—	—	Included
Year indicators	Included	Included	Included	Included	Included	Included
R^2: within	0.7974	0.8169	—	0.733	0.737	—
R^2: between	0.0735	0.0841	—	0.1381	0.4963	—
R^2: overall	0.2576	0.3345	—	0.1968	0.3842	—
# of Obs.	165	165	165	165	165	165
Impact of Rental Dir.	-3.62%	-7.70%	-5.39%	6.78%	9.22%	13.71%
Impact std. dev.	7.12%	9.64%	5.34%	13.21%	11.70%	8.30%

Notes:

1. All variables except indicators in natural logarithms
2. The Wooldridge test for autocorrelation in panel data rejected the null hypothesis of no first-order autocorrelation (F = 46.79, Pr(F > 46.79) = 0.0000). There was also strong evidence of heteroskedasticity in the residuals ($\chi 2$ = 144.30, Pr($\chi 2$ > 144.30) = 0.0000).
3. Robust cluster variance matrix.
4. Cross-sectional time-series panels.
5. The Wooldridge test for autocorrelation in panel data rejected the null hypothesis of no first-order autocorrelation (F = 200.69, Pr(F > 200.69) = 0.0000). There was also strong evidence of heteroskedasticity in the residuals ($\chi 2$ =1520.01, Pr($\chi 2$ > 1520.01) = 0.0000).

Figure 1: National and co-produced movies[1]



1. Including only the 12 countries for which data was complete for all years.

Figure 2: Movie production (natural logarithm) and compliance with Rental Directive

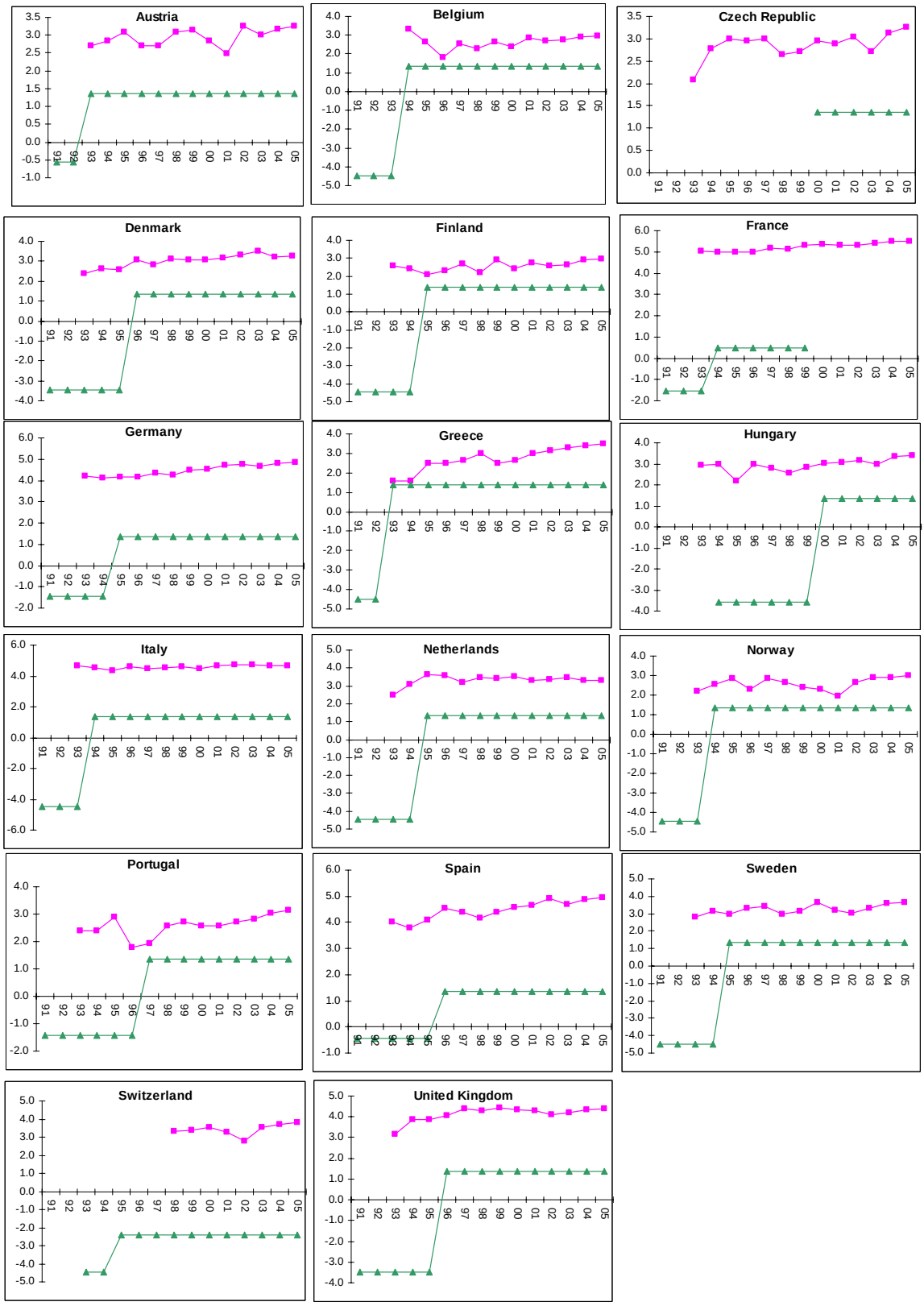


Figure 3: Impact of Rental Directive on movie production: Outlier check

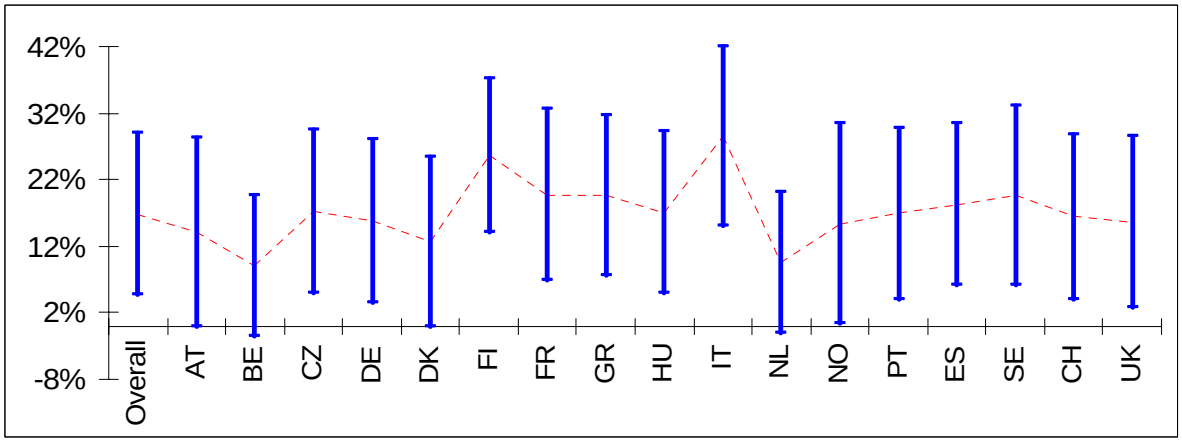
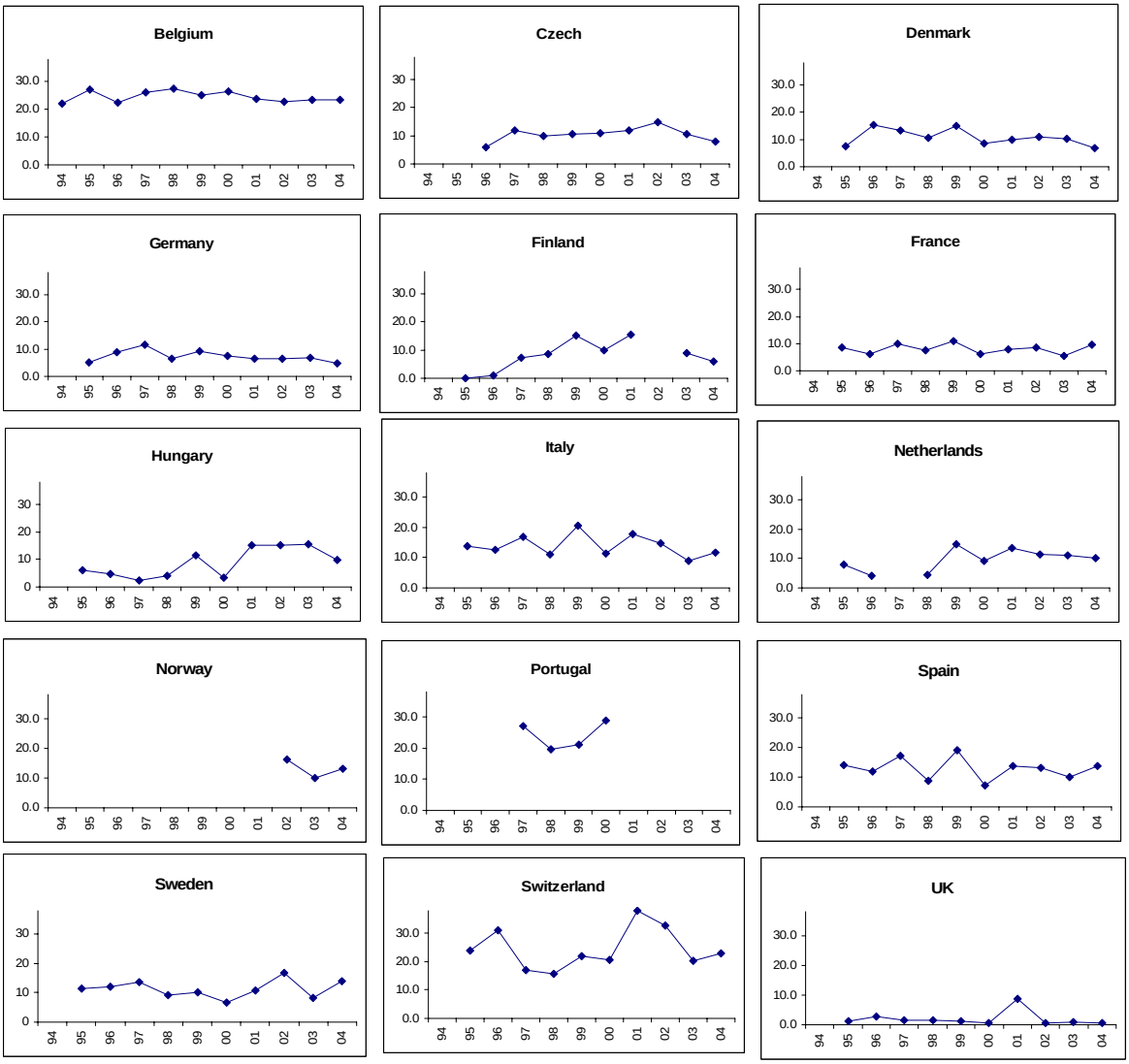


Figure 4: Market share of movies imported from other EU countries



Source: European Audiovisual Observatory, *2005 Yearbook: Film and Home Video*, Vol. 3.