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LAW AND INNOVATION IN COPYRIGHT INDUSTRIES

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Abstract. The impact of copyright law on innovation is a topic of much debate. We use quarterly data on aggregate copyright applications in both the U. S. and Canada to estimate an empirical model of copyright applications. We measure changes in the breadth of copyright protection by tabulating outcomes of important court cases and new statutes pertaining to copyright protection. We find that the flow of applications exhibits a small but significant positive response to court decisions broadening copyright protection. We also find that applications: 1) respond negatively to increases in registration fees 2) move counter-cyclically 3) have a strong seasonal component and 4) may increase as computing technology becomes more widely available.

1. Introduction

The proper breadth of copyright protection has been the subject of some debate and the continued expansion of copyright protection in the United States and other countries has created some controversy. U.S. copyright protection was established in 1790 with a maximum term of 28 years and has, at irregular intervals, expanded. In 1998 this term was expanded to the life of the author plus 70 years. In 1993 Europe experienced an identical expansion of copyright when the European Union harmonized copyright law across its member countries.[1] Some have argued that expanded copyright protection – through, for example, tougher infringement laws, broader definitions of protection, or most notably longer copyright terms – is vital in encouraging production of new intellectual property. Others argue that copyright protection has become excessive, and that additional protection only increases the rents accruing to existing copyrighted materials.[2] The tradeoff between creating

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[1]For additional discussion of these legal innovations in the U. S. and Europe, see Khan (2001), Png and Wang (2005) and Varian (2005).

[2]For example, a group of well-known economists prominently argued that the term extensions occur so late in the life of a creative work that they likely have a minimal impact on the present

rents for existing works and generating incentives for creation of new works has long been known in theory, and an optimal copyright policy should achieve balance between these two concerns. At the heart of the matter is the empirical question: how strongly do the creators of works respond to increases in the degree of copyright protection? How strongly does the legal environment influence the creation of new works?

In this paper we contribute to the growing body of empirical work on the relationship between the breadth of copyright protection and the production of new intellectual property.[3] Using new data on the quarterly flow of copyright applications, we investigate the relationship between changes in copyright law and the flow of copyright applications in Canada and the United States.[4] After controlling for a variety of non-legal determinants of application flow, we find that expanded copyright protection through courts exerts a significant, although small, positive impact on the flow of applications. Our results imply that one court case broadening copyright increases the flow of applications by .4% and that this effect dies out relatively quickly. An additional finding is that the flow of copyright applications is strongly impacted by registration fees and the real costs of registration. This result suggests that, as an alternative to copyright term extensions, creative innovation could be spurred by lower real fees for registration of copyright works. Our results are consistent with the findings of some other authors; for example, Png and Wang (2005), who find that international movie industry output increased in response to a 20 year extension to copyright.

The remainder of the paper is organized as follows: in Section 2 we describe our data on law and copyright registration applications. In Section 3 we present our empirical results and investigate the robustness of our findings. In Section 4 we conclude our discussion and describe some possibilities for future research.

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discounted return to creative activity (see Akerlof et. al., 2002). Lessig and Samuelson (1998) and Boynton (2004) also argue that the retroactive expansion of copyright prohibits entry of older works into the public domain, provides no obvious incentive effect, and increases the deadweight loss from consumption of the work. However, Landes and Posner (1989) predicts that recent decreases in the price of reproducing works should lead to an optimal expansion of protection. Liebowitz and Margolis (2005) also argue that there may be negative spillovers across consumers of creative works so that the use of works by particular individuals reduces the social value of a work.

[3]Other recent work in this area includes Towse (1999), Khan (2001, 2004), and Hui and Png (2002). These works have primarily focused on industry output and its relationship to changes in copyright law, and typically fails to find evidence of a relationship between law and returns / output in creative industries. Baker and Cunningham (2006), however, find evidence that changes case and statutory law pertaining to copyright significantly impacts the stock market valuation of firms in "copyright intensive" industries.

[4]We used Canada as the second country in our sample since court decisions are readily available in English and copyright application data was also available.

2. Data and Model Specification

Our empirical strategy is designed to identify the factors which influence the level of output in copyright industries. We begin with a description of our data on the state of copyright law as well as our data on the flow of copyrighted works. We then describe our empirical specification and the remaining variables which we include as potential determinants of creative activity.

2.1. **Measuring Copyright Protection.** In countries of British legal origin, law simultaneously evolves through statutes and precedent established by courts. The latter source of change in copyright law has generally been overlooked by most research, in spite of the fact that in many ways case law is more important to firms and individuals than statutory law, since it determines the practical means by which laws will be enforced. In prior work (see Baker and Cunningham, 2006) we established and implemented a technique for quantifying important changes in copyright case law in the United States. There, we followed a four step procedure in which we: 1) catalogued higher court decisions pertaining to copyright protection, 2) determined the date of the decision, 3) categorized the case according to whether the court's decision can be said to have broadened or narrowed copyright protection, and 4) constructed a quarterly index of the net change in the breadth of copyright law by subtracting the number of decisions narrowing protection from the number broadening copyright protection. Our source of important copyright court decisions is *Copyright Law Decisions*, a series of publications which summarizes all caselaw pertaining to copyright in the U.S.[5] From this publication, we extracted all cases heard in one of the 12 district courts of appeals, the Federal Circuit court of appeals, and the Supreme Court. More details on our case law measurement technique and the resulting index are provided in Baker and Cunningham (2006).

We use the copyright court decisions index from our prior research and supplement it with similar information deriving from Canadian case law. We use the *Canadian Patent Reporter* to identify important higher court copyright decisions over the 1985-2003 period.[6] We then create a quarterly index of changes in the breadth of Canadian copyright which is consistent with the U.S. index.[7] In a similar fashion we constructed an index of statutory changes impacting the breadth of copyright for the U.S. and Canada.[8]

[5]The first volume of the reporter is Commerce Clearing House (1981) and subsequent volumes are issued in approximately two year intervals. We used all volumes covering 1985-6 through 2002-3.
[6]The first volume of the *Canadian Patent Reporter* is Canada Law Book (1942).
[7]A spreadsheet listing each copyright case in the United States and Canada, the court of origin, and a brief description, can be downloaded from: http://www.usna.edu/Users/econ/bcunning/baker_cunningham_USCan_copyr.xls. This spreadsheet contains information on some U.S. district court cases. We did not use these lower court cases in our empirical analysis.
[8]Additional details on the U.S. statutory index are provided in Baker and Cunningham (2006). Our list of Canadian statutory changes was obtained from Huges and Peacock (2004).

Some of the findings from this exercise are as follows: there is a far lower level of court activity in Canada. The case law index contains 742 important court decisions which unambiguously influence the scope of U.S. copyright law in a particular direction. In contrast, we find only 45 comparable court decisions in Canada. U.S. courts seemed to only marginally increase the scope of copyright: we find 373 decisions which broadened copyright protection while 369 narrowed protection. In contrast, Canadian courts seemed to narrow copyright on the margin with 17 decisions broadening copyright and 28 decisions narrowing it. The statutory changes in our database, and their impact on the strength of copyright, are listed in Tables 1 and 2. Statutory copyright law changes far more often in the U.S. We have found 23 acts changing U.S. copyright with 20 acts broadening copyright and 3 acts narrowing. In Canada, all five statutory changes have broadened the scope of copyright protection.

Table 1. Canadian Statutory History

Statutory Change	**Number**	**Passed**	**Net Effect**
Amendments to the Copyright Act	SC 1988, c.15	6/88	+
Amendments to the Copyright Act	SC 1993, c.15 s.	6/93	+
Amendments to the Copyright Act	SC 1993, c.44	1/94	+
World Trade Organization Implementation Act	SC 1994, c.47	1/96	+
Amendments to the Copyright Act	SC 1997, c.24	4/97	+

2.2. **Copyright Industry Output.** Our measure of the creation of new copyright works is the quarterly flow of new applications for copyright with the U.S. Copyright Office and the Canadian Intellectual Property Office. This data series should serve as a reasonable measure of the pace of innovation in copyright industries. Unlike an alternative measure, such as value added, applications reflect changes in the volume of new existing works alone.[9]

[9]Our measure of innovation weights creative works equally, so it includes copyrighted material which may not yield significant social value. In addition, we are not able to differentiate between copyright registration activity by large organizations and registrations by individuals. The copyright offices gave us raw counts of registrations regardless of claimant information. In addition, claimant information in copyright records does not reflect any legal reassignment of copyright between an individual and a firm (these re-assignments are not observed by copyright offices). It is difficult to determine the fundamental source of new registrations and we leave this task to future research.

Table 2. U.S. Statutory History

Statutory Change	**Number**	**Passed**	**Net Effect**
Amendments to the Semiconductor Protection Act of 1984	98-620	11/87	+
Berne Convention Implementation Act of 1988	100-568	10/88	+
Amendment Pub. L. No. 100-617, 102 Stat. 3194	100-617	11/88	+
Copyright Remedy Clarification Act	101-553	11/90	+
Visual Artists' Rights Act of 1990	101-650	12/90	+
Architectural Works Protection Act	101-650	12/90	+
Computer Software Rental Amendments Act of 1990	101-650	12/90	+
Semiconductor International Protection Extension Act	102-64	6/91	+
Copyright Amendments Act of 1992	102-307	6/92	+
Copyright Renewal Act of 1992	102-307	6/92	+
Amendment Pub. L. No. 102-561, 106 Stat. 3145	102-492	10/92	+
Audio Home Recording Act of 1992	102-563	10/92	+
Satellite Home Viewer Act of 1994	103-369	10/94	+
Uruguay Round Agreements Act	103-465	12/94	+
Anticounterfeiting Consumer Protection Act of 1996	104-153	7/96	+
No Electronic Theft Act	105-147	12/97	+
Sonny Bono Copyright Term Extension Act	105-298	10/98	+
Fairness in Music Licensing Act of 1998	105-298	10/98	-
WIPO Copyright and Performances and Phonograms Act	105-304	10/98	+
Online Copyright Infringement Liability Limitation Act	105-304	10/98	-
Computer Maintenance Competition Assurance Act	105-304	10/98	-
Vessel Hull Design Protection Act	105-304	10/98	+
Digital Theft Deterrence/Damage Improvement Act of 1999	106-160	12/99	+

Since 1976, authors in the U.S. have been protected by copyright even when they do not formally register their works. Registration, however, remains an important technique for establishing the date on which an idea was initially expressed

and strengthens an author's claim to exclusivity in a number of ways. Registration is necessary for filing a lawsuit in the event of infringement. For example, in *La Resolana Architects v. Clay Realtors Angel Fire* (416 F.3d 1195 [10th Circuit 2005]), a U.S. court dismissed a copyright infringement suit, ruling that the plaintiff, an architectural firm, could not pursue an infringement action against a realtor for using the plaintiff's copyrighted building plans because the plaintiff brought suit before the plans had been successfully registered with the copyright office.[10] Provided registration occurs within five years of publication, it serves as *prima facie* evidence that a claim to copyright protection is valid. Moreover, in the event of a lawsuit alleging copyright infringement, a claimant can recover statutory damages only if s/he registered a work within three months of publication.[11] Statutory damages are an important component of any lawsuit involving copyright since: 1) the burden of proof is minimal (a claimant need not supply evidence of the extent of damage), 2) the claimant can be awarded for broader infringements, and 3) the damages are codified at $750 - $30,000 per infringing act.[12] An author is also likely to formally register a new work if s/he believe it has market value and is concerned with the possibility of infringement. For these reasons, registrations should capture the flow of new and potentially valuable creative activity.

There is more formal evidence that registrations capture a critical component of output in copyright industries. We have obtained annual data on value added for the U.S. movie / sound recording and publishing industry groups.[13] Our copyright registration data is also disaggregated for these two industry groups. The raw correlation between the growth of value added and the growth of copyright registrations is .28 and .08 for movies / sound recordings and publishing, respectively.[14] While these correlations are positive they are not large. Given the inherent delay in marketing and distributing copyright material after it is created, we have also calculated the raw correlation between the growth of value added and the first

[10]This case also discusses some of the recent history of law dictating the details of the registration process, and the debate about whether registration begins when the copyright office approves registration, or when the application for registration is submitted. Other cases discussing these and other aspects of the role of formal registration include *M.G.B. Homes, Inc. v. Ameron Homes, Inc.* (903 F.2d 1486, 1488 [11th Circuit 1990]) and *Mays and Associates v. Euler* (370 F. Supp. 2d 362, 368 [D. Maryland 2005]).

[11]For more information on the legal benefits associated with registration of works, see http://www.copyright.gov/circs/circ1.html#cr.

[12]For more information on the nature of statutory damages as a consequence of copyright infringement see http://chnm.gmu.edu/digitalhistory/links/pdf/chapter7/7.24b.pdf..

[13]This data is available from the U. S. Bureau of Economic Analysis (BEA) under the Annual Industry Accounts. For the publishing industry we have data during the years 1988 - 2004 and for the movie / sound recording industry group we have data from 1989 - 2004.

[14]We conducted this analysis for only the movie, sound recording and publishing industries since we couldn't precisely match the BEA and Copyright Office industry definitions for other areas of copyright activity. We use growth rates for all variables since they are each non-stationary.

lag of copyright registration growth. These correlations are .41 (movies / sound recordings) and .16 (publishing). In addition, the regression specification:

$$\textit{value added growth}_t = \beta_0 + \beta_1(\textit{copyright registration growth})_{t-1} + \varepsilon_t \qquad (1)$$

yields estimates of $\hat{\beta}_1 = .15$ (p-value = .005) for the movie / sound recording industries and $\hat{\beta}_1 = .35$ (p-value = .62) for publishing industries.[15] For at least one industry grouping, copyright registrations are a statistically significant leading indicator of output growth, as measured by value added. A one standard deviation increase in the growth rate of copyright registrations is associated with a .67% increase in the growth of value added for movies / sound recordings after the passage of more than one year.[16] This is an economically significant increase since the mean of value added growth is 3.6% with a standard deviation of .65%. These results suggest that registration activity is importantly related to broader outcomes in copyright industries.[17]

There is one concern with using registrations as a measure of copyright industry output. Our empirical approach will yield reliable results provided the length of time between the creation of works and registration is constant and / or exogenous. Variable lags between creative innovation and registration will introduce noise in our data. This increases the likelihood that we won't find empirical evidence of a relationship between law and copyright activity (we are more prone to making a Type II error). We mention this because government agencies sometimes see large spikes in applications for copyright registration.[18] An influx of works can create a "logjam" in processing applications. At such times the lag between application and registration increases. We use non-public data on quarterly applications for copyright registration as our measure of copyright industry output in order to reduce the influence of variable lags. We were able to obtain this data for the years 1994-2005 in Canada and 1986-2004 in the United States.[19,20]

[15] White's heteroscedastic-robust standard errors were used for this regression.

[16] Copyright registrations are measured over fiscal years, which begin three months before the calendar year measure of value added. The regression specification indicates the impact of registrations on value added after the passage of 1 year and three months.

[17] We intend to further explore the relationship between innovation and value added in future work.

[18] We learned of this possibility in conversations with members of the U. S. Copyright Office's Policy and Planning Program.

[19] We also note that, unlike patents, applications for copyright registration are not examined for originality. For more on this point, see Posner (2005). This implies that, after application, a work will only fail to be registered if there is some type of error in the application (illegibility, inadequate payment, etc.). We also note that some of the works which are ultimately registered may not be truly original or innovative. Our results should be careful interpreted in light of these considerations.

[20] We provide a detailed discussion of the role of balance in our panel later in the paper.

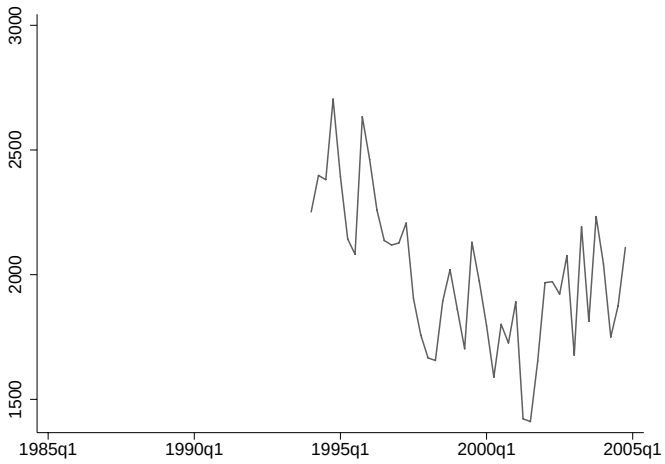

FIGURE 1. Copyright Applications – Canada

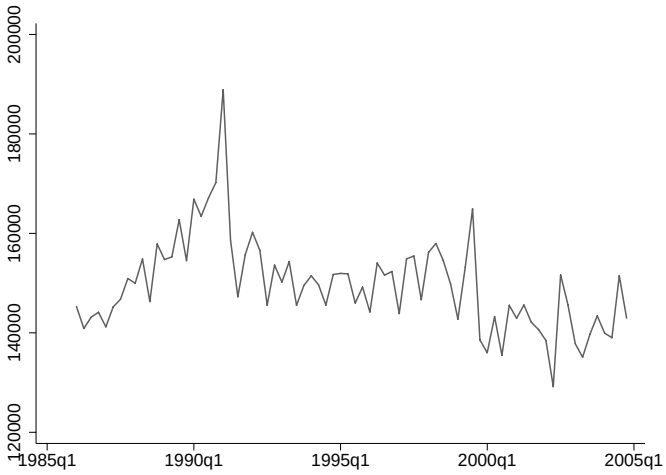

FIGURE 2. Copyright Applications – USA

The quarterly flow of applications in these two countries is shown in Figures 1 and 2. Summary statistics are presented in Table 3.[21] The volume of copyright activity is, not surprisingly, much greater in the U.S. than it is in Canada. Average quarterly applications in the U.S. are about 155,000, whereas the average is

[21]We have removed quarterly seasonal effects (discussed further below) from the raw U.S. application data in order to produce Figure 2. Unlike the figures, summary statistics for applications in Table 3 are measured in hundreds.

approximately 2,000 in Canada.[22] Further, copyright applications are more volatile in Canada: the standard deviation of applications is 15% of mean applications in Canada and 6% in the U.S. Both applications series exhibit a long-run decline. Regression estimation of a simple linear trend suggests that there is a statistically significant decrease of 179 applications per quarter in the U.S. and 12 applications per quarter in Canada, although there are short-run deviations from this trend.[23] Applications have exhibited a short-run increase in Canada since the third quarter of 2001 and there were sharp increases in U.S. applications during 1991:Q1, 1999:Q3 and 2002:Q3 (we use fiscal years throughout the paper).

Table 3. Summary Statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Apps	1009	741.1	14.11	1925	110
Growth	3.185	1.492	-1.003	5.929	110
Pop	184.6	115.5	29.04	294.0	110
Openness	41.49	26.719	17.15	86.36	110
ExpectedFee	0.045	0.209	0.000	1.000	110
RealFee	27.51	10.65	12.10	49.47	110
Statutes	0.174	0.575	0.000	4.000	109
Cases	-0.118	2.841	-8.000	7.000	110
Internet	188.0	192.7	0.000	551.4	108
PersComp	334.3	145.2	107.0	658.9	108
$Int \times PC$	88725	108073	0.00	363291	108

[22]Along with market size, the fact that Canadians might be interested in registering their works in the U. S. may help to explain why US registration flow is much larger than the Canadian flow.
[23]The decline in copyright applications may be attributable to increasing levels of piracy / unauthorized reproduction over our sample horizon. We use a number of proxies to test for this possibility and find that higher internet penetration is negatively associated with registrations in the U.S.

Table 3a. Summary Statistics by Country

United States					
Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Apps	1552	103.5	1386	1925	71
Growth	3.077	1.427	-1.003	5.038	71
Pop	269.3	14.85	245.9	294.0	71
Openness	22.00	2.309	17.15	26.83	71
ExpectedFee	0.056	0.232	0.000	1.000	71
RealFee	21.45	5.949	12.10	30.61	71
Statutes	0.243	0.690	0.000	4.000	70
Cases	-0.155	3.512	-8.000	7.000	71
Internet	160.2	192.0	0.000	551.4	69
PersComp	340.5	164.1	106.0	659.0	69
$Int \times PC$	84900	117887	0.000	363290	69
Canada					
Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Apps	19.845	2.994	14.11	27.04	39
Growth	3.382	1.604	0.588	5.929	39
Pop	30.36	0.780	29.044	31.51	39
Openness	76.98	5.95	64.08	86.36	39
ExpectedFee	0.026	0.160	0.000	1.000	39
RealFee	38.54	8.170	26.65	49.47	39
Statutes	0.051	0.223	0.000	1.000	39
Cases	-0.051	0.647	-2.000	2.000	39
Internet	237.2	186.3	12.18	512.8	39
PersComp	323.3	104.6	175.6	487.0	39
$Int \times PC$	95491	89134	2139	249770	39

In order to evaluate the issue of breaks in the trend for applications we use the Elliott and Muller (2006) test for parameter stability. At the 1% level we reject the null of a stable trend in copyright applications in the U.S. and Canada. If we allow for three segments to the trend in applications for the U.S. we find a significant positive trend prior to 1991, a significant but weaker negative trend during 1991-2000, and a statistically insignificant trend from 2001 onward. If we allow for a break in trend in Canada beginning in 2000 we find a significant negative trend in the early part of the sample and a weaker but significant and positive trend in the later part of the sample.

How strongly does the flow of applications respond to various features of the economy? To answer this question, we consider four categories of variables which

can potentially influence the level of applications for copyright registration. A detailed description of each variable and its source is offered in Table 4. For all versions of our empirical specification, we include a vector of economic and demographic variables for country i and quarter t: Δ_{it}. For a variety of reasons there may be a cyclical component to creative activity. During a business cycle expansion, demand for books, movies, music and software will increase as long as they are normal goods. On the other hand, if leisure is complementary to the production of creative works, an increase in work hours during an upturn could lead to a contraction in the volume of new works created. In order to determine whether copyright activity is procyclical or countercyclical, we include the growth rate of real GDP (*Growth*) in our specification. We also include the population (*Pop*) in order to determine whether the size of a market exerts an influence on the flow of creative works. Our last economic control is a measure of openness defined as exports plus imports divided by GDP (*Openness*). An open market allows authors to easily export their works abroad and may stimulate a larger flow of copyright applications. On the other hand, openness may lead to increased competition, reduce the markup of price over marginal cost, and decrease the incentive to produce creative works. We hope to ascertain which of these effects are dominant.

Table 4. Data Sources

Variable	**Description**	**Source**
Apps	copyright registration applications (in hundreds)	USCO & CIPO
Growth	quarterly growth rate of real GDP	IMF-IFS
Pop	population (in millions)	IMF-IFS
Openness	exports plus imports divided by GDP	IMF-IFS
Expected Fee	dummy variable, =1 in quarter prior to statutory fee increase	USCO & CCB
Real Fee	real copyright application fee, in US$'s (2000)	USCO, CCB & IMF-IFS
Statutes	net number of statutes broadening copyright in a quarter	BC & HP
Cases	net number of court decisions broadening copyright in a quarter	BC & CLB
Internet	internet subscribers per thousand	WB-WDI
PersComp	personal computers per thousand	WB-WDI

where;

- USCO is the U.S. Copyright Office

- CIPO is the Canadian Intellectual Property Office
- IMF-IFS is the International Monetary Fund, International Financial Statistics database
- CCB is the Canadian Copyright Board
- BC is Baker and Cunningham (2006)
- HP is Hughes and Peacock (2004)
- CLB is the Canada Law Book (1942)
- WB-WDI is the World Bank, World Development Indicators

Note that our dates for the change in copyright registration fee were obtained through direct communication with the USCO and the CCB as well as the report of fees located at http://www.copyright.gov/reports/fees2002.pdf and a search of Lexis-Nexis Canada. The US dollar value of the Canadian registration fee was calculated using spot exchange rate statistics from the IMF-IFS.

Our second group of explanatory variables includes measures of the cost of applying for copyright registration: Γ_{it}. In Canada, the copyright registration fee increased in 1998:Q1 while in the U.S. the fee increased in 1991:Q2, 1998:Q4, 1999:Q4 and 2002:Q4.[24] Through media reports and official "rule making" announcements, the public is generally made aware of these fee changes prior to their implementation. Authors may accelerate their production of works in order to avoid anticipated increases in fees. To control for this behavior we include a dummy variable which is one in the quarter prior to an increase in copyright application fees and zero otherwise ($ExpectedFee$). Between changes in nominal fees, the real cost of copyright applications declines as a consequence of inflation. We include contemporaneous values of the real fee for a basic copyright application ($RealFee$) as an additional explanatory variable. This variable is measured in U.S. dollars. We use the spot U.S. / Canadian dollar exchange rate to convert the real Canadian application fee to U.S. dollars. We are implicitly assuming that a depreciation of the U.S. currency encourages Canadians to register their works in the larger U.S. market.[25] The real application fee allows us to control for legal changes in the cost of copyright activity and we anticipate that it will obtain a negative coefficient.

Our next group of variables contains measures of the legal strength of copyright: Λ_{it}. There are two variables in this group: our quarterly count of the net number of

[24]This list includes statutory and discretionary changes to fees for all types of registration activity (such as basic and expedited registration).

[25]If a Canadian author registers her/his work in Canada a variety of international agreements such as the Berne Convention will protect the work in the U.S. Authors may consequently view registration abroad as a substitute for domestic registration. Our prior belief is that, because of the larger U.S. market, Canadian authors are more willing to substitute registration abroad so we don't adjust U.S. registration fees for the appreciation or depreciation of the U.S. dollar.

statutes which broaden copyright (*Statutes*) and the net number of higher court decisions which broaden copyright protection (*Cases*). Provided law has a sufficiently large influence over the incentives to create works, and a broader copyright encourages creative activity, the coefficient on this variable should be positive. On the other hand, if a stronger copyright law limits the ability of some authors to derive new works from copyrighted materials, our legal variables may obtain insignificant or negative coefficients. We also consider the possibility that legal changes in one country might influence copyright applications abroad. There are two mechanisms by which this possibility could arise. A stronger foreign copyright might encourage authors to register their works abroad in which case our cross-boarder legal variables (*XStatutes* and *XCases*) will obtain negative coefficients.[26] Alternatively, stronger foreign protection could allow authors to more easily profit from exporting their works and encourage domestic innovation.

Our last group of variables capture the level of technology which is available to producers and consumers of copyrighted works: Θ_{it}. We include the number of internet subscribers per thousand (*Internet*) in order to control for improvements in the transmission of information. Rising internet access has facilitated both authorized and unauthorized distribution of copyrighted materials. If rising internet usage primarily encourages piracy we might find a negative coefficient on *Internet*. Conversely, greater use of the internet could increase copyright applications by: 1) increasing the size of the copyright market and / or 2) lowering the cost of authoring since information is frequently an input in the production of information. We also include the number of personal computers per thousand (*PersComp*) as an explanatory variable. Distributed and inexpensive computing can reduce the cost of creative activity and can also facilitate unauthorized reproduction. Since internet and personal computer adoption may exhibit a complicated relationship with creative innovation, we also include an interaction term ($Int \times PC$).[27]

[26] *XStatutes* (*XCases*) in country i and quarter t is defined as the *Statutes* (*Cases*) observed in country j and quarter t.

[27] There may be a concern that our dependent and independent variables are non-stationary and this may lead to spurious regression results. We applied the Im, Pesaran and Shin (2003) test for non-stationarity in panel data to each of our variables. Using one lag we rejected non-stationarity for copyright applications and GDP growth. We failed to reject non-stationarity for openness, population, internet and personal computers. Subject to the usual caveats regarding the power of these tests, we are not concerned with spurious results since we have evidence supporting stationarity in our dependent variable. In order to further evaluate the role of nonstationarity in our results we replaced the nonstationary variables with their first differences. We found that our first-difference specification was qualitatively comparable to the results reported below with the exception of loss of significance for the population and personal computer coefficients.

3. Empirical Specification and Results

We use a linear empirical specification in order to obtain evidence of the determinants of copyright industry productivity in our panel of two countries:

$$apps_{it} = \alpha_0 + \eta_i + \alpha_1' \cdot \Delta_{it} + \alpha_2' \cdot \Gamma_{it} + \alpha_3' \cdot \Lambda_{it} + \alpha_4' \cdot \Theta_{it} + \alpha_5' \cdot \delta_t + \alpha_6 \cdot apps_{it-1} + \epsilon_{it} \quad (2)$$

where η_i is a country fixed-effect and α_i $(i = 1, 2, \ldots, 6)$ are column vectors of parameters.[28] The 3×1 column vector δ_t of quarterly dummy variables controls for any seasonal component to creative activity or application processing. It has a one in row i if an observation occurs in quarter i.[29] We also control for persistence in copyright applications by including the first lag of applications as an explanatory variable.[30] Because we assume a fixed effect along with a first-order autoregressive process for our dependent variable, traditional techniques for estimating the parameters in (2) will not be consistent. We use the estimator described in Arellano and Bond (1991) in order to obtain consistent estimates.

Our empirical results are in Table 5. We begin by estimating a baseline model which includes the possible economic and demographic determinants of copyright industry productivity along with our quarterly dummy variables and the first lag of applications. A lag of the rate of economic growth is included to control for a delay in the transmission of economic fluctuations. We find three statistically significant results. Two are positive coefficients on the first and second quarterly dummy variables, suggesting there is a seasonal component to copyright applications. Copyright applications rise by approximately 3,800 during the October-December period and peak with an additional 4,100 applications during the first three months of a new year (January - March). This pattern may be a consequence of summer touring in the music industry or any other activity (such as marketing of books and / or movies) which reduces creative efforts in the summer months. It might also be explained by seasonal application processing. We also find significant evidence of some persistence in copyright applications. Our autoregressive parameter of .44 suggests more than half of a shock to copyright applications dies out after one quarter.

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[28] We do not employ logs in our specification since we don't anticipate significant non-linearities. When we do estimate our specification with the log of copyright applications as the dependent variable and heteroscedasticity – robust standard errors the results are qualitatively similar. These results are available upon request from the authors.

[29] Our omitted dummy variable category is the fourth quarter.

[30] Applications are measured in hundreds. Note that the variables *Pop*, *Internet*, and *PersComp* are only available at an annual frequency so caution should be used when interpreting the coefficients on these variables.

Table 5. Dependent Variable - Copyright Applications

	(1)	(2)	(3)	(4)	(5)	(6)
$Growth_{it}$	−11.78 (8.73)	−12.4 (7.05)*	−12.32 (6.93)*	−11.58 (6.89)*	−15.17 (7.01)**	−17.25 (7.27)**
$Growth_{it-1}$	8.32 (8.95)	10.27 (7.2)	11.08 (7.11)	10.8 (7.06)	13.23 (7.08)*	15.79 (7.43)**
Pop_{it}	−1.76 (1.65)	−3.69 (1.36)***	−3.85 (1.34)***	−3.67 (1.33)***	−6.06 (2.07)***	−5.76 (2.13)***
$Openness_{it}$	0.45 (1.95)	2.04 (1.69)	2.29 (1.67)	2.25 (1.66)	1.11 (2.05)	2.08 (2.18)
$ExpectedFee_{it}$	·	148.13 (24.79)***	139.67 (25.23)***	140.08 (25.97)***	149.58 (25.84)***	152.65 (26.43)***
$RealFee_{it}$	·	−4.1 (1.27)***	−4.49 (1.29)***	−4.39 (1.28)***	−3.95 (1.26)***	−4.3 (1.3)***
$Statutes_{it}$	·	·	11.58 (9.73)	11.58 (9.68)	6.46 (9.56)	4.88 (10.16)
$Statutes_{it-1}$	·	·	14.32 (9.8)	12 (9.9)	5.69 (9.82)	1.27 (10.37)
$Cases_{it}$	·	·	·	−0.52 (1.9)	−0.34 (1.98)	−0.26 (2.02)
$Cases_{it-1}$	·	·	·	3.67 (1.85)**	4.54 (1.89)**	4.7 (2)**
$Internet_{it-1}$	·	·	·	·	−0.12 (0.25)	−0.21 (0.26)
$PersComp_{it-1}$	·	·	·	·	0.65 (1.14)	0.73 (1.18)
$Int \times PC_{it-1}$	·	·	·	·	−.0004 (.0008)	−.0003 (.0009)
$XStatutes_{jt}$	·	·	·	·	·	−0.3 (17.79)
$XStatutes_{jt-1}$	·	·	·	·	·	−26.87 (16.79)
$XCases_{jt}$	·	·	·	·	·	−2.24 (2.3)
$XCases_{jt-1}$	·	·	·	·	·	−2.81 (2.25)
$Quarter\ 1_t$	38.44 (17.78)**	32.53 (14.18)**	27.96 (14.79)*	28.47 (14.67)*	21.78 (15.26)	21.26 (16.02)
$Quarter\ 2_t$	79.2 (17.61)***	83.57 (14.03)***	77.96 (14.24)***	77.86 (14.12)***	76.04 (17.46)***	79.4 (18.27)***
$Quarter\ 3_t$	22.83 (17.74)	13.27 (14.18)	14.96 (14)	13.81 (13.9)	13.91 (14.72)	10.31 (15.22)
$Apps_{it-1}$	0.44 (.09)***	0.36 (.07)***	0.32 (.07)***	0.36 (.08)***	0.26 (.08)***	0.27 (.09)***
T_{US}	71	71	70	70	67	67
T_{Can}	39	39	39	39	39	38
N	110	110	109	109	106	105
χ^2	52.1***	128.7***	135***	142***	142.7***	144***

Notes: (1) Standard errors in parenthesis, ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. (2) Vairable definitions: T_i - number of quarters observed for country i. N - total observations. (3) All estimates obtained using

Arellano-Bond (AB) dynamic panel estimator. The sample period depends upon the specification. In column (4) the Canadian sample covers 1994:3 - 2004:1 and the US sample covers 1986:4 - 2004:1. (4) T_{US} - number of quarters of observations for the United States, T_{Can} - number of quarters of observations for Canada, N - number of observations, χ^2 - Wald test of joint significance of all coefficients (with degrees of freedom 8, 10, 12, 14, 17, and 21 for each of the specifications).

In the second column of Table 5 we add $ExpectedFee$ and $RealFee$ to the regression specification, which reveal that an expected increase in fees has a relatively large impact on new copyright applications. The flow of copyright applications increases by approximately 14,800 in the quarter preceding a fee increase; after the increase, the flow of applications decreases. The coefficient estimate suggests that a real increase in fees of US$1 is, on average, associated with approximately 400 fewer copyright applications per quarter. The average real application fee is US$28 (2000 dollars) with a standard deviation of US$11. The low value of this fee, coupled with our finding that registrations respond strongly to fees, suggests that a sizeable portion of those applying for copyright registration expect their work has a low market value.[31]

We also find that applications are counter-cyclical; a standard deviation increase in real economy-wide growth leads to 1,800 fewer copyright applications. This result is consistent with a complementarity between leisure and creative activity. We also obtain a significant and negative coefficient on the size of the population. Since the population of both economies in our sample are smoothly growing, the coefficient on Pop may capture the long-run downward trend in copyright applications alongside any relationship between the size of an economy and creative innovation.[32]

In the third column we add our count of the net number of statutes broadening copyright. We include one lag of $Statutes$ in order to capture the possibility that authors may learn of or respond to statutory changes with some delay. While the coefficients on the contemporaneous and lagged values of the statutory variables are both positive, they are not precisely estimated. Thus, we find no strong evidence that statutory changes significantly impact the flow of applications. There are a number of possible explanations for this result. First, there may be mis-measurement of statutory law in our data. In addition, there may be great

[31] Analysis of the expected market value of works is complicated by the fact that copyrighted works provide a risky stream of revenue and the level of risk aversion among innovators is unknown.

[32] In a simple fixed-effects regression of the level of applications on a linear time trend, we obtain a negative and significant coefficient on the trend variable. When we add the population to this specification, the coefficient on the time trend, while still negative, is not statistically significant (the coefficient on population is also negative and not statistically significant). We interpret this as evidence that the population variable is controlling for some of the downward trend in applications.

uncertainty over the practical implications of statutory changes prior to court interpretation of those changes. In prior research we failed to find significant evidence that statutory legal changes have an impact on the stock market value of smaller firms.[33] If creative activity is concentrated among such firms, statutory law may not exhibit a significant impact on registrations. In the fourth column of Table 5 we add contemporaneous and once lagged values of the net number of court decisions broadening copyright. The coefficient on the contemporaneous value of $Cases$ is small, negative and insignificant. The coefficient on the lagged value of $Cases$ is positive and significant at the 5% level. Thus, copyright applications increase by approximately 370 one quarter after a high court decision strengthens copyright protection.[34]

In the fifth column we add our measures of technological advancement ($Internet$, $PersComp$, and $Int \times PC$) to our specification. We lag these variables by one year since creative activity may respond with some lag to the integration of technology.[35] We obtain a negative coefficient on internet usage and a positive coefficient on personal computer adoption but neither coefficient is precisely estimated. Our prior results continue to hold with two exceptions: we find a statistically insignificant coefficient on the first quarterly dummy variable and the autoregressive coefficient on applications is fairly low. The coefficient on the lag of $Cases$ increases in magnitude. In addition, we find weak evidence that copyright applications exhibit lagging pro-cyclical behavior: one quarter after growth increases by a standard deviation, copyright applications increase by approximately 200. An increase in economic activity seems to bring forth greater demand for and supply of copyright activity after a short delay. In the last column of Table 5 we add our cross-border legal variables (contemporaneous and once lagged) to the specification. While all coefficients on $XStatutes$ and $XCases$ are negative, none are significant.

[33] See Baker and Cunningham (2006) for additional discussion of this result.

[34] When we replace total case counts with separate case counts variables for supreme court and circuit court decisions we find a significant positive coefficient on circuit court cases. All other coefficients are insignificant. This provides some evidence that lower court decisions are playing a stronger role in determining copyright application flows.

[35] In Baker and Cunningham (2006) we found evidence that copyright industries respond with some delay to copyright-related shocks. For this reason we employ lags in our specification.

Table 6. Robustness Results

	(1)	(2)	(3)	(4)	(5) U.S.	(6) Canada
$Growth_{it}$	−12.36 (10.21)	−11.53 (10.71)	−14.55 (7.52)*	−16.82 (7.85)**	−16.43 (9.14)*	0.18 (.56)
$Growth_{it-1}$	8.56 (12.31)	8.76 (7.99)	13.07 (8.51)	15.7 (6.93)**	13.06 (7.83)*	0.21 (.54)
Pop_{it}	−1.39 (.76)*	−1.14 (.72)	−6.01 (2.34)**	−5.7 (2.04)***	−14.82 (9.21)	12.69 (8.79)
$Openness_{it}$	2.93 (2.42)	3.15 (2.38)	0.94 (1.57)	1.98 (3.02)	10.66 (8.48)	−0.14 (.22)
$ExpectedFee_{it}$	144.86 (27.88)***	136.95 (29.38)***	148.28 (23.59)***	151.69 (31.48)***	165.12 (33.99)***	−0.24 (3.55)
$RealFee_{it}$	−3.08 (1.23)**	−3.18 (1.26)**	−3.89 (1.23)***	−4.26 (1.8)**	−9.14 (2.95)***	−0.18 (.1)*
$Statutes_{it}$	·	10.78 (6.67)	6.57 (10.24)	5 (6.17)	9.32 (12.13)	−0.85 (1.57)
$Statutes_{it-1}$	·	8.1 (6.75)	5.17 (8.18)	0.82 (8.54)	−0.31 (11.75)	−0.96 (1.83)
$Cases_{it}$	·	−0.65 (2.13)	−0.41 (2.02)	−0.31 (1.66)	−0.51 (1.95)	−0.47 (0.58)
$Cases_{it-1}$	·	3.81 (1.49)**	4.58 (1.81)**	4.74 (.97)***	3.58 (2.39)	−0.1 (.57)
$Internet_{it-1}$	·	·	−0.1 (.23)	−0.2 (.33)	−0.64 (.36)*	−0.02 (0.04)
$PersComp_{it-1}$	·	·	0.88 (.44)**	0.88 (.4)**	2.41 (1.26)*	−0.19 (.12)
$Int \times PC_{it-1}$	·	·	−.0006 (.0004)	−.0004 (.0005)	−.0007 (.001)	−.0002 (.0001)
$XStatutes_{jt}$	·	·	·	−0.14 (18.68)	·	·
$XStatutes_{jt-1}$	·	·	·	−26.81 (14.15)*	·	·
$XCases_{jt}$	·	·	·	−2.27 (1.63)	·	·
$XCases_{jt-1}$	·	·	·	−2.86 (2.93)	·	·
$Quarter\ 1_t$	35.01 (12.35)***	31.18 (9.21)***	23.5 (13.08)*	22.54 (9.77)**	23.86 (21.24)	−1.22 (1.03)
$Quarter\ 2_t$	80.99 (8.03)***	76.35 (10.88)***	73.95 (12.05)***	78.11 (8.07)***	116.43 (18.68)***	−1.95 (.99)**
$Quarter\ 3_t$	12.12 (7.53)	12.11 (6.74)*	12.19 (15.42)	8.96 (7.03)	13.74 (17.57)	−1.87 (1.03)*
$Apps_{it-1}$	0.38 (.06)***	0.39 (.08)***	0.27 (.05)***	0.28 (.1)***	0.2 (.09)**	0.01 (.2)
N	110	109	106	105	68	40
R^2	·	·	·	·	0.83	0.76

Notes: (1) Bootstrapped standard errors are in parentheses, ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively. (2) Variable definitions: T_i - number of quarters observed for country i. N - total observations. (3) The estimates in columns (1)-(4) were obtained through Least Squared Dummy Variable (LSDV) estimation. A sample which is limited in its cross-sectional observations and / or unbalanced

will create a bias in AB estimates. LSDV corrects for these sources of bias. Estimates in columns (5) and (6) are obtained by Ordinary Least Squares (OLS) estimation. The sample period depends upon the specification. In column (2) the Canadian sample covers 1994:3 - 2004:1 and the US sample covers 1986:4 - 2004:1.

Our sample is unbalanced and has the smallest possible cross-section (two countries). Each of these sample characteristics can reduce the reliability of an Arellano-Bond (AB) estimator.[36] In order to determine the robustness of our results, we use a bias-corrected Least Squared Dummy Variable (LSDVC) estimator. As described by Bruno (2005a, 2005b), Arellano-Bond estimates can be biased when they are obtained from a sample with a small number of cross-sectional units.[37] A specific LSDVC procedure is required to correct this bias when a panel is unbalanced; the results from bias-corrected estimation are given in Table 6. We first estimate a baseline model with economic, demographic, and application cost controls. The bias-corrected results are largely consistent with our AB estimates with two minor exceptions: the coefficient on Pop and $Real\ Fee$, though statistically significant, are smaller in absolute value and have larger standard errors. In the second column of Table 6 we add our legal variables to the specification. The coefficient on the first lag of $Cases$ is entirely consistent with the corresponding AB estimate. In addition, the contemporaneous value of $Statutues$ is marginally significant in predicting copyright applications (p-value of .108). We find weak evidence that a statute which broadens copyright increases the flow of applications by approximately 1,000.[38]

In the third column we add our measures of technological adoption to the specification. The coefficient on $PersComp$ is positive and statistically significant at a 5% level and implies that applications increase by approximately 12,700 one year after personal computer ownership increases by a standard deviation. This result is consistent with the notion that wider availability of computing reduces the cost of creative activity. We add the cross-border legal variables ($XStatutes$ and $XCases$) and their lags in the fourth column of robustness results. We find evidence that a broader foreign copyright reduces domestic copyright activity with some delay. The coefficient on the first lag of $XStatute$ is negative and significant at a 10% level. In summary, our results from bias-corrected estimation are fundamentally consistent with our AB findings and provide additional evidence that statutes, technological

[36]The Aherns and Pincus (1981) measure of balancedness for our sample is $\omega = .993$. Since a completely balanced panel will generate $\omega = 1$, we believe our empirical results are not greatly compromised by unbalancedness.

[37]We also ran a simple Instrumental Variables (IV) estimator in order to evaluate the impact of limited cross-sectional units. We used three lags of population to instrument for the lag dependent variable. Specific results are available upon request from the authors. The IV results were qualitatively similar to our AB and LSDVC results.

[38]Note that, in contrast to the corresponding AB estimate, contemporaneous countercyclical fluctuations in applications are not significant in this specification.

advancement, and cross-border effects may play a role in determining copyright activity.

As an additional robustness check we estimate our specification separately for the U.S. and Canada (see the last two columns of Table 6, we don't test for cross-border results in this specification). Since we use an Ordinary Least Squares estimator these coefficients are not directly comparable to our AB and LSDVC estimates. We present these findings in order to provide a sense of the extent to which the model's general results apply to each country. The OLS results for the U.S. are fundamentally consistent with the AB and LSDVC estimates although the lag of *Cases* is not statistically significant for the U.S. We also find a negative and significant coefficient on *Internet* implying that a representative increase in internet subscriptions is associated with a drop of 12,300 U.S. copyright applications. This result provides weak evidence that internet "piracy" may reduce creative incentives in the U.S. Our specification is notably less effective at predicting Canadian copyright applications. Creative activity is slightly lower during the January - June months in Canada. We also find statistically significant evidence that a real increase in application fees reduces Canadian applications although the magnitude of this effect is quite small (18 applications are lost for each US$1 real increase in the application fee). Our general empirical results from AB / LSDVC estimation seem to be most relevant for the United States.

Our final robustness check involves replacing the *Pop*, *Openness*, *Internet* and *PersComp* variables with their first differences (we also interact the first differences of *Internet* and *PersComp*). As mentioned earlier, there is some evidence that these variables are non-stationary. Since we also have evidence suggesting that copyright applications themselves are stationary it is appropriate to use first differences of potentially non-stationary variables as explanatory variables. With these first differences we obtain a positive and significant coefficient on the population variable, indicating that when there is an increase in population there are a larger number of copyright applications. The sign and significant of the other variables does not appreciably change the inferences we have drawn from our baseline specification.[39]

4. Conclusion

Copyright law has significantly changed over the past 30 years. Prior evidence suggests that a stronger copyright law increases the stock market value of firms in creative industries but there is limited evidence that stronger copyright law translates into increased output of creative works. We have found some empirical support for the notion that court decisions which broaden copyright increase the flow

[39]These results are available upon request from the authors.

of creative activity and somewhat weaker evidence that stronger statutes increase innovations. Our evidence also suggests that creative activity: 1) moves countercyclically 2) has a strong seasonal component 3) has weak persistence and 4) may increase as computing technology is adopted. Foremost among our findings is the strong response of creative activity to the cost of registering new works. Copyright bureaucracies have indirectly encouraged creative innovation by keeping nominal application fees constant for long periods of time. Low copyright registration fees may be one of the most effective means of encouraging creative innovation.

We see a number of potentially fruitful extensions to this research. It seems that stronger copyright law encourages additional creative activity. A more detailed theoretical framework should allow greater insights into the relationship between legal changes, creative innovation, pricing in excess of marginal cost, and stock market valuation. Future research could also extending our legal measurement technique to additional countries. A larger cross-section of countries would provide interesting insights into the international determinants of creative innovation.

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