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Does Copyright Law Promote Creativity? An Empirical Analysis of Copyright's Bounty

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Modern copyright law is based upon a theory: increase copyright protection and you increase the number of creative works available to society. This theory has been the driving force behind an economic vision that has expanded, beyond all recognition, the original law created by the Statute of Anne. And with this expansion, we are told that the costs associated with copyright are worthwhile because of the bounty it produces. What if this theory could be tested? After all, this is not a question of faith or morality, nor is it a statement on how humans should behave; it is a theory about how humans do behave. In this Article, we use statistical analysis to test the theory that increasing copyright protection usually increases the number of new creative works. Relying upon U.S. copyright registrations from 1870 through 2006 as a proxy for the number of works created, we consider how four variables— population, the economy, legal changes, and technology—influenced subsequent copyright registrations. Our findings cast serious doubt on the idea that with copyright law, one size fits all. While individual legal changes may be associated with changes in subsequent copyright registrations, the overall relationship between changes in copyright law and registrations is neither consistent nor completely predictable.

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Raymond Shih Ray Ku,* Jiayang Sun,** Yiying Fan***

I. INTRODUCTION

In 1841, Thomas Babington Macaulay delivered a speech in the British Parliament in which he famously described copyright as "a tax on readers for the purpose of giving a bounty to writers."[1] While critics of copyright law often use this quote as a general objection to copyright, that was not the intent. Macaulay was not opposed to copyright per se. Instead, he was skeptical that a proposal to increase the length of copyright protection would yield much in return. Following this famous quote, Macaulay went on to say:

> I admit, however, the necessity of giving a bounty to genius and learning. In order to give such a bounty, I willingly submit even to this severe and burdensome tax. Nay, I am ready to increase the tax, if it can be shown that by so doing I should proportionally increase the bounty. My complaint is, that my hon[orable] and learned [f]riend doubles, triples, quadruples, the tax, and makes scarcely any perceptible addition to the bounty.[2]

As such, the problem was not copyright itself, nor even the monopoly costs associated with copyright, which he described in that same speech as a necessary evil.[3] The problem was that changing copyright law and expanding copyright's exclusive rights might not provide the public with any real benefit. While Macaulay was successful in defeating the 1841 effort to expand copyright,[4] more often than not, lawmakers have not shared his skepticism.[5]

In the United States, the history of copyright law is one of expansion. For example, in 1790, copyright originally provided authors the exclusive right to vend books and maps for fourteen years with an additional fourteen years of protection available through renewal.[6] Currently, copyright protects all original expression fixed in a tangible medium of expression, which includes books, motion pictures, sound recordings, broadcasts of sporting events, and video games.[7] It provides authors the exclusive right to control almost all uses of their writings—even the ability to create new works based

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1.   56 PARL. DEB., H.C. (3d ser.) (1841) 350, *reprinted in* PRIMARY SOURCES ON COPYRIGHT (1450–1900) (L. Bently & M. Kretschmer eds.), www.copyrighthistory.org [hereinafter PARLIAMENTARY DEBATES].

2.   *Id.*

3.   *Id.* at 348.

4.   *Id.* at 360.

5.   *See, e.g.*, Act of May 31, 1790, c. 15, § 1, 1 Stat. 124.

6.   *Id.*

7.   17 U.S.C. § 102 (2006); Williams Elec., Inc. v. Artic Int'l, Inc., 685 F.2d 870, 875 (3d Cir. 1982).

upon the original.[8] Moreover, this protection generally lasts for the life of the author plus an additional seventy years.[9]

The logic behind this expansion is straightforward. Copyright law provides authors with exclusive rights in their works.[10] In turn, these exclusive rights allow successful authors to obtain financial reward for their works by creating a market for them instead of forcing them to seek private or government patronage. The greater the protection, the greater the reward; the greater the reward, the greater the incentive to create new works; and the greater the incentive to create new works, the greater the number of new works created. To paraphrase Macaulay, by increasing the financial bounty available to authors, we ultimately increase the public's bounty of new works of authorship.[11] In other words, copyright law promotes creativity.[12]

The argument may be simply summarized: if a little copyright is good, more is better. While logical, this position is still a theory and, like all theories, can be tested. Unfortunately, even though copyright has existed and continuously expanded for hundreds of years, there has been little research done to test the theoretical basis for copyright's expansion.[13] In fact, so little has been done that one author specifically pled for more empirical research.[14] This study responds to that need.

In this Article, we use statistical analysis to examine whether changes in copyright law influence the number of new works created. Relying upon U.S. copyright registrations from 1870 through 2006 as a proxy for the number of works created, we consider how four

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8.   17 U.S.C. § 106.

9.   *Id.* § 302(a).

10.   *Id.* § 106.

11.   PARLIAMENTARY DEBATES, *supra note 1*, at 350.

12.   I use this term loosely, and it would be more accurate to say that copyright encourages or rewards the creation of new works, and not that these works are necessarily more imaginative or insightful.

13.   *See, e.g.,* WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 210 (2003); Brief of George A. Akerlof & Kenneth J. Arrow et. al as Amici Curiae in Support of Petitioners, Eldred v. Ashcroft, 537 U.S. 186 (2003) (No. 01-618); *see also* Paul J. Heald, *Property Rights and the Efficient Exploitation of Copyrighted Works*, 92 MINN. L. REV. 1031, 1034 (2008) (analyzing whether lack of copyright protection led to underutilization of fictional books). While some have argued against the need for any copyright protection, *see* MICHELE BOLDRIN & DAVID K LEVINE, AGAINST INTELLECTUAL MONOPOLY 7 (2008) (concluding that copyright, trademark, and patent rights are a "unnecessary evil"); Stephen Breyer, *The Uneasy Case for Copyright: A Study of Copyright in Books, Photocopies, and Computer Programs*, 84 HARV. L. REV. 281, 350 (1970) (asserting that "the general case for copyright is weak"), our study does not address that question. Instead, it examines whether changes to copyright law after 1870 affect subsequent copyright registrations.

14.   *See* Ivan P.L. Png, *Copyright: A Plea for Empirical Research*, 3 REV. ECON. RES. ON COPYRIGHT ISSUES 3 (2006) (summarizing the available research and finding it insufficient).

variables—population, the economy, changes in the law (both legislative and judicial), and technology—influenced new copyright registrations. From the data, we test the following hypotheses. The *major hypothesis* is that any change in copyright protection will result in changes in the number of works produced. The related *minor hypotheses* are that increasing copyright protection will increase the number of works produced and—its corollary—that decreasing copyright protection will reduce the number of works produced.

Despite the logic of the theory that increasing copyright protection will increase the number of copyrighted works, the data do not support it. Instead, our findings demonstrate that the historic long-run growth in new copyrighted works is largely a function of population.[15] Sharp changes are mostly due to procedural shifts in copyright registration, such as those created by the Berne Convention Implementation Act of 1988.[16]

This is the first comprehensive study examining the relationship between changes in copyright law and changes in new copyright registrations. It employs statistical change-point analysis, parametric time series regression analysis, and nonparametric regression analysis with simultaneous confidence bounds around the registration growth curves. It relies upon the most complete set of data for U.S. copyright registrations to date. Moreover, instead of relying entirely upon overall registration data, this study examines the relationship of changes in copyright law with respect to individual categories of works, including monographs and sound recordings, and sub-categories of works, such as performing arts. It considers all fifty-six congressionally created statutes and Supreme Court decisions that occurred between 1870 and 2006 together with four other concurrent variables—population, the economy, registration fees, and technological change.

The only published work on this topic to date anecdotally considered five changes of the law and observed that two laws extending the length of copyright protection yielded no statistically significant changes in the number of new works produced.[17]

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15. Our findings complement the results of Michael Kremer's work on the relationship between population and technological change. *See* Michael Kremer, *Population Growth and Technological Change: One Million B.C. to 1990*, 108 Q. J. ECON. 681, 681–716 (1993). Kremer's model, however, holds constant the "share of resources devoted to research," *id.* at 681, while our study includes legal and technological change as variables that may alter the share of resources devoted to artistic creation.

16. Pub. L. No. 100-568, 102 Stat. 2853 (codified as amended in scattered sections of 17 U.S.C.).

17. LANDES & POSNER, *supra* note 13, at 247.

Nonetheless, the authors of that study, William Landes and Richard Posner, continue to contend that increasing copyright protection should generally increase the number of new works produced.[18] They argue that term extension is an aberration because "the expected commercial life of a copyrighted work is so much shorter than the copyright term that it makes a lengthening of the term irrelevant to most potential registrations."[19] Presumably, laws that expand copyright protections to new works and grant authors new rights, remedies, and penalties against those who infringe those works are more likely to influence authors. These laws increase the opportunities and markets that successful copyright owners may exploit during the commercial life of the work. In other words, increasing the length of copyright increases the amount of time an author may benefit from a particular revenue stream, while a change in the breadth of copyright increases the number and reliability of revenue streams. If one views copyright's incentive regime as analogous to a lottery,[20] by adding the right to control public performances, digital distribution, and derivative works, the law effectively expands the size of the copyright jackpot. Likewise, changes to the remedies available for violations of copyright law, such as providing copyright owners with statutory damages or increasing the prison time for criminal infringement, help assure authors that their payoffs will be protected.

Contrary to Landes and Posner's suggestion, our study reveals that their anecdotal observations regarding term extension are not aberrational. Instead, our findings demonstrate that there is no uniform or fully predictable statistical relationship between laws that increase copyright term, subject matter, rights, or criminal penalties and the number of new works registered in general. Overall, the most one can expect is a 38 percent chance that a law increasing copyright protection will lead to an increase in the number of new registrations for a single, unknown category of copyrighted work. Laws that reduce or otherwise limit copyright protection are actually more likely to increase the number of new works. Even then, the relationship is far from uniform or predictable. As such, the data suggest that these relationships may be essentially random. Population is uniformly and

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18. *Id.*

19. *Id.*

20. *Cf.* F.M. Scherer, *The Innovation Lottery*, in EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY 3–21, (Rochelle Dreyfuss, Diane Leenheer Zimmerman, & Harry First eds., 2001) (discussing the lottery aspects of intellectual property regimes); JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 73–74 (1942) (describing this phenomenon as part of a capitalistic economy).

consistently the best predictor of the number of new works produced. So while increasing copyright protection may increase the rewards available to authors, it does little to change their incentives overall.

Consequently, this study provides valuable insight into the relationship between law and human behavior. A growing body of research in law, psychology, and economics asks the same question: Does law actually influence individual decisionmaking and behavior? In other words, when and under what circumstances does law matter? When law *does* influence individual behavior, how do individuals react to the rewards and penalties created by law? For example, social norms theorists have focused on the relationship between law and social norms,[21] and behavioralists have studied, among other things, whether the death penalty actually serves as a deterrent to crime.[22] While the traditional economic model of human behavior has formed the theoretical basis for the proposition that increasing legal protection for copyrighted works should increase the number of new works created, this Article argues not only that there is little empirical support for that uniform proposition, but that—when properly understood—the rational, wealth-maximizing model itself does not predict such a change in behavior. This insight is critically important for evaluating copyright policy and the balance of costs and benefits associated with copyright protection, and it therefore contributes to our understanding of how individuals respond to legally created incentives. Specifically, this study increases our understanding of when and under what circumstances individuals will likely change their behavior—here, by producing more creative works—in response to changes in the potential rewards made possible by legally created rights.

Part II of this Article discusses copyright's historic growth and the incentive justification for copyright's expansion. This history includes the central role that the incentive justification played in the U.S. Supreme Court's decision in *Eldred v. Ashcroft*, which upheld Congress's decision to extend copyright protection by an additional twenty years.[23] Part III reviews the existing empirical research and explains how this study adds to this underdeveloped body of literature. Part IV explains our study, including a general description

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21. *See generally* THE BLACKWELL COMPANION TO LAW AND SOCIETY (Austin Sarat ed., 2004).

22. *See* Cass R. Sunstein & Adrian Vermeule, *Is Capital Punishment Morally Required? Acts, Omissions, and Life-Life Tradeoffs*, 58 STAN. L. REV. 703, 710–16 (2005) (summarizing the debate); *see also* Steven D. Levitt, *Understanding Why Crime Fell in the 1990s: Four Factors That Explain the Decline and Six that Do Not*, 18 J. ECON. PERSP. 163, 174 (2004).

23. 537 U.S. 186, 206–17 (2003).

of our methodology and our findings. A detailed discussion of the statistical methodology, modeling, and results is included in the statistical appendix that follows this Article.[24] Based upon this analysis, Part IV concludes that the data do not support the major or minor hypotheses—let alone the proposition that increasing copyright protection always increases the number of new copyrighted works produced. Part V explains why many of the changes to copyright law do not appear to influence the number of new works produced by authors. It further argues that our understanding of the existing economic model predicting such a change is incomplete and, more fundamentally, relies upon dubious assumptions. As such, Part V contends that even a basic economic model of human behavior does not support the proposition that increasing copyright protection will increase the number of new works produced. While increasing copyright protection provides authors with the opportunity to obtain greater rewards, these changes in the law do not create additional incentives to create new works. After arguing that scant empirical or theoretical support exists for expanding copyright protection as a reliable strategy to increase the number of new copyrightable works, Part VI of this Article concludes by outlining four general strategies for increasing the number of such works in the future.

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24. *See infra* app. 1.

II. EXPANSION AND EXPLANATION

A. COPYRIGHT'S GROWTH

It is often said that death and taxes are the only guarantees in life. After even a cursory examination of the history of copyright law, one might add that the expansion of copyright law is guaranteed as well. As discussed above, in the United States copyright originally provided authors the exclusive right to vend books and maps for fourteen years, with an additional fourteen years of protection if renewed. Currently, copyright protects all original expression fixed in a tangible medium.[25] This expansion did not happen all at once. Instead, it is the product of the gradual accretion of copyright protection as the result of both legislative enactment and judicial judgments. As Chart 1 illustrates, Congress has consistently given copyright owners control over additional uses of their works and has increased the length of time during which they might exercise such control.[26]

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25.   17 U.S.C. § 106 (2008).

26.   Two important areas of copyright expansion are not represented in Chart 1. The first involves the term of copyright protection. Originally, the length of copyright protection was divided into an original term and a renewal term. In order to benefit from the renewal term copyright owners were required to file a renewal registration. Failure to file such a registration meant that copyright law would no longer protect the work. As part of Congress' revision of copyright law in 1976, copyrighted works created after January 1, 1978 are now subject to a unitary term. 17 U.S.C. § 302(a). As such, the chart notes the potential maximum length of protection without regard to renewals. The chart also does not note the changes in copyright formalities such as registration, notice, and deposit that also affect the substantive rights that may be enjoyed by copyright owners.

CHART 1. INCREASING COPYRIGHT PROTECTION OVER TIME
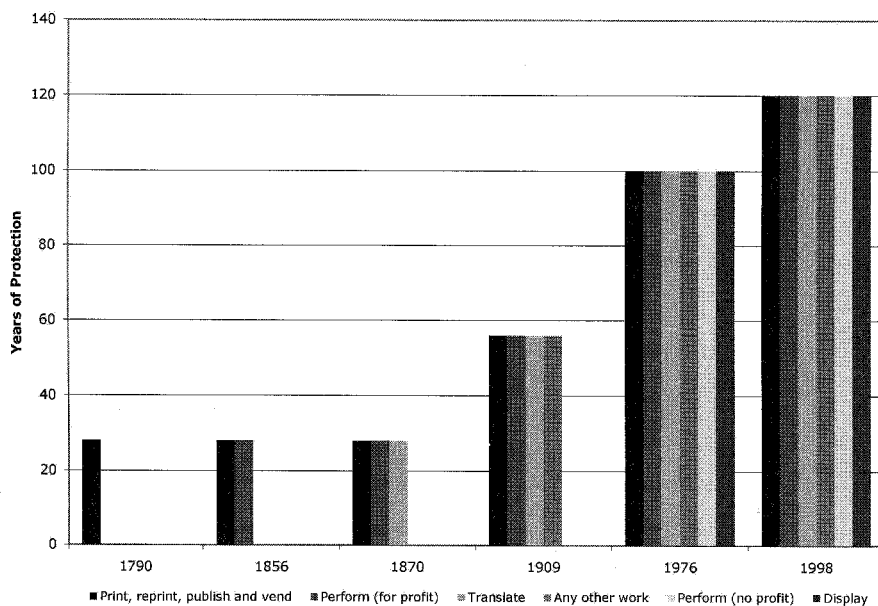
While the scope of copyright has expanded over time, it is equally true that, as a general matter, the number of copyrighted works produced each year has also increased. Charts 2 and 3 illustrate this increase in the number of copyrighted works produced. Chart 2 displays the aggregate number of copyright registrations, including renewal registrations, filed each year from 1870 to 2006. Chart 3 illustrates the total number of new registrations filed in various subcategories. At first blush, it appears that there is a relationship between copyright's expansion and the number of new works created. Likewise, it also appears that there is some support for the claim that new technologies—including digital technologies and the Internet— may have disrupted the otherwise steady growth of creative works.

CHART 2. COPYRIGHT REGISTRATIONS (1870-2006)
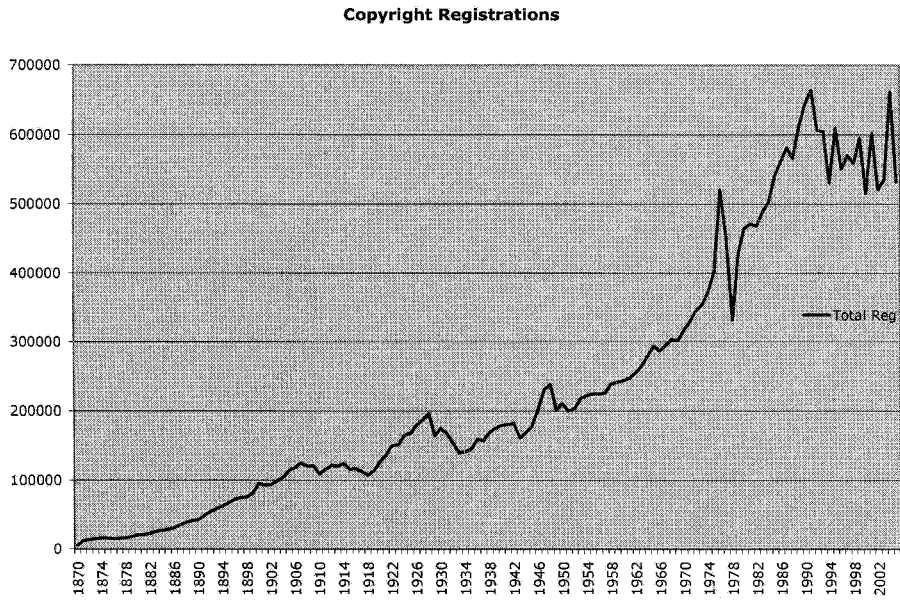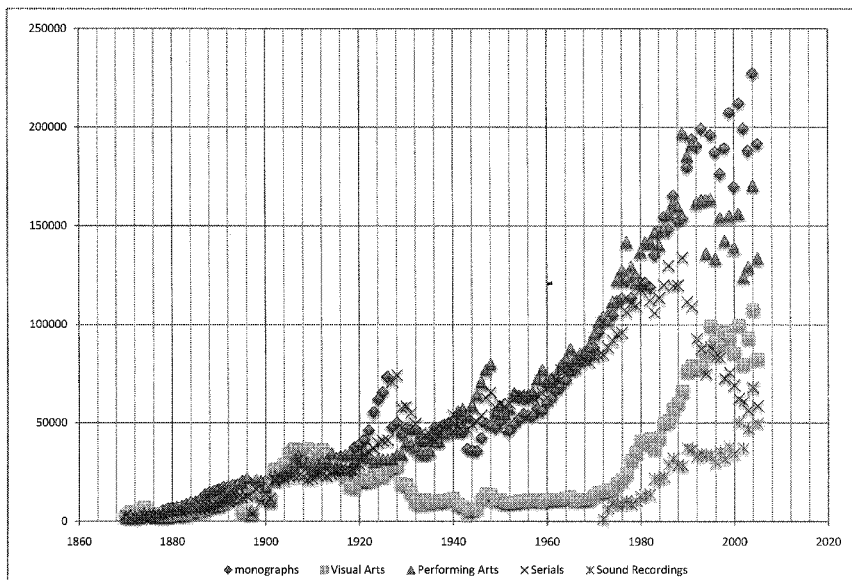
Copyright Registrations

CHART 3. COPYRIGHT REGISTRATIONS BY SUBCATEGORIES (1870-2006)

After all, there has been a precipitous drop in the number of copyright registrations after 1991, which some may identify as the year that the most recent array of disruptive technologies were first introduced.[27] Likewise, the number of copyright registrations also became increasingly volatile after 1991.

While the remainder of the paper is dedicated to analyzing the claim that increased legal protection leads to more copyright registrations, the claim that new technologies are hurting creativity can be challenged rather quickly. First, as illustrated in Chart 3, the drop in serial registrations—that is, registrations for newspapers, magazines, and other periodicals—accounts for a substantial portion of the drop in overall copyright registrations. Prior to 1991, these registrations were on par with the number of registrations for monographs. After 1991, these registrations began to decline rapidly to the point that serial registrations currently represent less than one-fourth of the number of registrations for monographs. This decline might be explained by the changing nature of the market caused by factors such as industry consolidation, competition from competing media outlets in cable television (and subsequently, the Internet), and increased copyright infringement.

However, the decline may also be directly linked to changes in U.S. Copyright Office policy. For works published after January 7, 1991, the Copyright Office began allowing copyright owners to file group registrations rather than individual registrations for serials published at intervals of one week or longer.[28] Similarly, the Copyright Office began allowing daily newspapers to file group registrations effective September 1, 1992[29] and daily newsletters to file group registrations for their works as well after July 1, 1999.[30] Because of these changes in the rules for registration, the decrease in serials registrations may not reflect a decrease in the number of serials produced, but instead a decrease in the number of registrations filed. So while changing markets and technology may still be factors, they are by no means the only—or even the best—explanations for the decline in serial and, therefore, overall registrations.

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27. 1991 was the year in which CERN launched the World Wide Web (WWW). ROBERT H. ZAKON, HOBBES INTERNET TIMELINE (2006), http://www.zakon.org/robert/internet/timeline/. By comparison, Napster, which ushered in the era of peer-to-peer file sharing, was not introduced until 1999. Alejandro Zentner, *Piracy and Filesharing: Measuring the Effect of File Sharing on Music Purchases*, 49 J.L. & ECON. 63, 63–64 (2006).

28. 37 C.F.R. §§ 202.3, 202.20.

29. *Id.* § 202.3.

30. *Id.*

Second, the increased volatility in registrations after 1991 illustrated in Charts 2 and 3 may be the result of procedural changes regarding copyright registrations as well. As will be discussed in greater detail below, the overall rules regarding the filing of copyright registrations were dramatically altered as a result of the United States' accession to the Berne Convention for the Protection of Literary and Artistic Works and the adoption of the Berne Convention Implementation Act, both of which went into effect in 1989.[31] Among other things, the Implementation Act eliminated any need for certain non-U.S. works to file copyright registrations.[32] As such, at least some of the instability following 1991 may be the result of a reduction in the number of foreign works seeking copyright protection in the United States under the Berne Convention. This reduction may have been caused by a general (albeit possibly erroneous) perception that as a party to the Berne Convention, all formalities—including copyright registration—are no longer required to receive copyright protection in the United States. Once again, while disruptive technologies and piracy may have depressed the number of new copyrighted works created after 1991, there are other potential explanations for these changes.

B. Justification

As discussed above, providing creators with economic incentives to create new works is one of the principal justifications, if not *the* justification, for copyright's expansion. As the U.S. Supreme Court noted, "The immediate effect of our copyright law is to secure a fair return for an 'author's' creative labor. But the ultimate aim is, by this incentive, to stimulate artistic creativity for the general public good."[33] But what level of incentives is appropriate? Many scholars have argued that copyright laws need only "provide the owner sufficient incentives to produce such property," which means "something less than 'perfect control.' "[34] Otherwise, the benefits of increased copyright protection may be offset by the harms created by

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31. Pub. L. No. 100-568, 102 Stat. 2853 (Oct. 31, 1988).

32. *Id.*

33. Twentieth Century Music Corp. v. Aiken, 422 U.S. 151, 156 (1975), *superseded by* Act of Oct. 19, 1976, ch. 1, Pub. L. No. 94-553, 90 Stat. 2550, *as recognized in* Crabshaw Music v. K-Bob's of El Paso, Inc., 744 F. Supp. 763, 766 (W.D. Tex. 1990); *see also* Stewart E. Sterk, *Rhetoric and Reality in Copyright Law*, 94 MICH. L. REV. 1197, 1203 (1996) ("[I]t is incentive language that pervades the Supreme Court's copyright jurisprudence . . . .").

34. Lawrence Lessig, *Intellectual Property and Code*, 11 ST. JOHN'S J. LEGAL COMMENT. 635, 638 (1996).

denying the public access to creative works and the opportunity to create their own works.[35] These scholars have bemoaned the fact that, whether in response to new technologies and economic opportunities[36] or simply at the behest of copyright stakeholders,[37] Congress essentially employs "a one way ratchet, increasing the subject matter, scope, and duration of copyright with every amendment."[38]

One reason for this distress among copyright scholars is that the logic and rhetorical force of the expansionist position is difficult to dismiss. Expansionists can simply argue that greater copyright protections lead to greater rewards for creators, which themselves lead to greater incentives to create new works, ultimately benefiting the public by providing them more original creations.[39] The natural extension of this argument is that if a little copyright law is good, more is always better. As Sara Stadler observed, this argument does

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35.   The scholarly debate in this area is extremely rich and deep. *Compare* PAUL GOLDSTEIN, COPYRIGHT'S HIGHWAY: FROM GUTENBERG TO THE CELESTIAL JUKEBOX (rev. ed., Stanford Univ. Press 2003); LANDES & POSNER, *supra* note 13; Jane C. Ginsburg, *Copyright and Control over New Technologies of Dissemination*, 101 COLUM. L. REV. 1613 (2001), *with* JAMES BOYLE, THE PUBLIC DOMAIN (2008); LAWRENCE LESSIG, FREE CULTURE: HOW BIG MEDIA USES TECHNOLOGY AND THE LAW TO LOCK DOWN CULTURE AND CONTROL CREATIVITY (2004); JESSICA LITMAN, DIGITAL COPYRIGHT (2001); NEAL WEINSTOCK NETANEL, COPYRIGHT'S PARADOX (2008); Yochai Benkler, *Free as the Air to Common Use: First Amendment Constraints on Enclosure of the Public Domain*, 74 N.Y.U. L. REV. 354 (1999); Julie Cohen, *Lochner in Cyberspace: The New Economic Orthodoxy of "Rights Management,"* 97 MICH. L. REV. 462 (1998); Wendy J. Gordon, *An Inquiry into the Merits of Copyright: The Challenge of Consistency, Consent, and Encouragement Theory*, 41 STAN. L. REV. 1343 (1989); Mark A. Lemley, *Property, Intellectual Property and Free Riding*, 83 TEX. L. REV. 1031 (2005); Pamela Samuelson, *Intellectual Property and the Digital Economy: Why the Anti-Circumvention Regulations Need to be Revised*, 14 BERKELEY TECH. L.J. 519 (1999).

36.   *See* Jane C. Ginsburg, *Essay: How Copyright Got a Bad Name for Itself*, 26 COLUM. J.L. & ARTS 61, 64 (2002) (arguing that Congress "appropriately reache[d] out to address new problems prompted by new technologies, so as to strike a happier balance").

37.   *See* Jessica D. Litman, *Copyright, Compromise, and Legislative History*, 72 CORNELL L. REV. 857, 860–61 (1987) (explaining that copyright stakeholders, not Congress, developed the language of the Copyright Act of 1976).

38.   Jessica Litman, *War Stories*, 20 CARDOZO ARTS & ENT. L.J. 337, 344 (2002); *see also* Dennis S. Karjala, *Copyright Protection of Operating Software, Copyright Misuse, and Antitrust*, 9 CORNELL J.L. & PUB. POL'Y 161, 163 (1999) ("Congress has a ratchet for copyright protection that sends it in only one direction – more for owners of existing copyrights and less for current and future authors and for the public generally."); David McGowan, *Why the First Amendment Cannot Dictate Copyright Policy*, 65 U. PITT. L. REV. 281, 282 (2004) ("Many copyright scholars object to the way Congress deals with their subject. With good reason, they feel Congress wields a copyright ratchet: terms get longer, and the scope of rights gets wider, but never the reverse."); Rebecca Tushnet, *Copy This Essay: How Fair Use Doctrine Harms Free Speech and How Copying Serves It*, 114 YALE L.J. 535, 543 (2004) ("Legally, then, copyright has been a one-way ratchet, covering more works and granting more rights for a longer time.").

39.   PARLIAMENTARY DEBATES, *supra* note 1, at 350.

"tend to the tautological."[40] Nevertheless, it is quite powerful, and it cannot be dismissed out of hand, especially when one considers that there is little agreement on what incentives are sufficient to produce more original works as well as the inherent difficulty in determining the economically optimal level of copyright protection.

Consider the argument for giving copyright owners the exclusive right to control derivative works (i.e., works that are based upon and incorporate an existing work). According to Paul Goldstein, allowing the copyright owner of the original work to control such uses should increase the number of new works created because the "publisher who knows that it can license, and obtain payment for, the translation, serialization, condensation and motion picture rights for a novel will invest more in purchasing, producing and marketing the novel than it would if its returns were limited to revenues from book sales in the English language."[41] We are told that this greater investment will mean increased access not only to the original work but also to the licensed derivative works. In some cases, the exclusive right to control derivative works may be important because of high initial costs for creating the original work or because the ability to exclusively exploit these alternative sources of revenue allows investment in so-called "riskier" projects. For example, a motion picture studio is more likely to invest in both big budget and avant-garde films when it can obtain exclusive rights to downstream revenue sources of these films—including hotel, cable, satellite, and broadcast retransmission, DVD sales and rentals, digital downloads, books, and associated merchandising.[42]

Assuming that people are capable of evaluating and are motivated by the additional incentives provided by the right to control derivative works, expanding copyright to include the right to control derivative works sounds reasonable. In fact, as Jessica Litman notes, when constrained by the assumption that this model accurately describes how people behave, the answer to the question of "whether an increase in copyright protection will lead to the production of more or better works," is always yes, and "there is no good reason why copyrights should not cover everything and last forever."[43] Framed in these terms, whether Congress should expand copyright depends upon how one weighs the relative benefit of additional creative works

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40. Sara K Stadler, *Incentive and Expectation in Copyright*, 58 HASTINGS L.J. 433, 435 (2007).

41. Paul Goldstein, *Derivative Rights and Derivative Works in Copyright*, 30 J. COPYRIGHT SOC'Y U.S. 209, 227 (1983).

42. Raymond Shih Ray Ku, *Grokking* Grokster, 2005 WIS. L. REV. 1217, 1256.

43. Litman, *supra* note 38, at 344.

against the costs associated with expanding copyright law. As illustrated by the U.S. Supreme Court's decision in *Eldred v. Ashcroft,* in the absence of a compelling justification to do so, courts are not inclined to second-guess Congress under these circumstances.[44]

In *Eldred,* plaintiffs challenged Congress's decision to extend the length of copyright protection by an additional twenty years.[45] They argued that the Copyright Term Extension Act ("CTEA") passed in 1998 violated both the Copyright Clause's "limited Times" prescription and the First Amendment guarantee of freedom of speech.[46] In upholding the CTEA, the Supreme Court concluded that "[t]he CTEA reflects judgments of a kind . . . we cannot dismiss as outside the Legislature's domain."[47] According to the Court, Congress "rationally credited projections that longer terms would encourage copyright holders to invest in . . . their works" because of the incentives created by term extension.[48] The Court noted that in reaching this conclusion, Congress relied upon the testimony of a number of artists—including Quincy Jones, Bob Dylan, Don Henley, and Carlos Santana.[49] Congress also heard the testimony of the Register of Copyrights Marybeth Peters and others who expressed the belief that the CTEA would provide valuable additional incentives to create.[50] According to the Register, extending copyright could "provide additional income that would finance the production and publication of new works."[51]

Reminiscent of Macaulay, Justice Breyer argued in dissent that the CTEA "will not act as an economic spur encouraging authors to create new works."[52] According to Justice Breyer, "the incentive-related numbers are far too small for Congress to have concluded rationally, even with respect to new works, that the extension's economic-incentive effect could justify the serious expression-related harms" created by term extension.[53] In reaching this conclusion, Justice Breyer relied upon studies finding that: (1) very few works survive long enough for term extension to matter (only 2 percent of all copyrights retain any commercial value after fifty-five to seventy-five

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44. 537 U.S. 186, 208, 212 (2003).
45. *Id.* at 193.
46. *Id.*
47. *Id.* at 205.
48. *Id.* at 207.
49. *Id.*
50. *Id.* at 207 n.15.
51. *Id.*
52. *Id.* at 254 (Breyer, J., dissenting).
53. *Id.* at 257.

years), and (2) even if it were reasonable for an artist to believe that her work may be one of those few, the present value to her would amount to less than seven cents.[54] As such he opined: "What potential Shakespeare, Wharton, or Hemingway would be moved by such a sum?"[55] Moreover, even if "somehow, somewhere, some potential author might be moved by the thought of great-grandchildren receiving copyright royalties a century hence, so might some potential author also be moved by the thought of royalties being paid for two centuries, five centuries, 1,000 years, 'til the End of Time.' "[56] In other words, the logic of this position would not only justify the CTEA; it would justify perpetual copyrights, rendering the incentive argument "difficult to square with the Constitution's insistence on 'limited Times.' "[57]

Nonetheless, the seven-member majority concluded that Congress's decision was rational and consistent with the proposition that it is primarily for Congress to calibrate "rational economic incentives."[58] In short, the Supreme Court was unwilling to question Congress's reliance upon the logic that increasing incentives enlarges the number of new works created—even when those increases are so small they could be considered illusory. While logical, this position is still a theory and—fortunately—one that can be tested.

III. EXISTING EMPIRICAL RESEARCH

Even though copyright has existed and continuously expanded for hundreds of years, there has been little empirical research done to test the logic behind copyright's expansion.[59] As *Eldred*[60] illustrates, copyright's expansion is largely based upon the testimony of those who would benefit from such an expansion—artists and industry—and the

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54. *Id.* at 254–55.

55. *Id.* at 255.

56. *Id.*

57. *Id.* at 256.

58. *Id.* at 207 n.15.

59. To date, empirical studies in this area have focused primarily upon the commercial value of copyrighted works and the relationship between piracy and the sale of copyrighted works. *See, e.g.*, Olufunmilayo B. Arewa, *The Freedom to Copy: Copyright, Creation, and Context*, 41 U.C. DAVIS L. REV. 477, 507–08 (2007) (noting the "lack of empirical studies with respect to copyright incentives" and the "range of other potential uses of copyright [that] are largely ignored"); Matthew J. Baker, *Court Decisions and Equity Markets: Estimating the Value of Copyright Protection*, 49 J.L. & ECON. 567, 569 (2006) ("Existing empirical work on copyright protection . . . focuses on either the relationship between infringement and copyright protection or the relationship between production of copyrightable goods or revenue streams and protection.").

60. 537 U.S. at 186.

common-sense judgment that even small increases in financial incentives will lead to more new works. As one of us has argued elsewhere, this omission may be explained by the fact that the financial incentives created by copyright traditionally encouraged the creation *and* distribution of creative works.[61] Moreover, until the widespread adoption of digital technology and the global distribution made possible by the Internet, copyright was considered necessary to encourage the widespread distribution of creative works—even if those works would have been created without copyright.[62] Because these technologies essentially represent a new distribution paradigm in which the continued enforcement of copyright's exclusivity rights leads to the under-distribution of creative works, scholars are now paying attention to the law's role in the creation of creative works.

One analysis conducted by Landes and Posner attempted to infer the optimal duration of copyrights.[63] This study focused primarily on copyright renewals and the depreciation value of works in an effort to estimate the expected economic life of copyrighted works and the impact of term extension upon that value. In conducting this analysis, the authors also examined the relationship between five statutory law changes upon total registrations from 1910 to 2000. In their analysis, the authors also considered year-to-year changes, the impact of copyright registration and renewal fees, the expected life of the copyright, and annual recreational expenditures. Relying upon logarithmic models, the authors found statistically significant year-to-year growth in the rate of copyright registrations based upon what they concluded to be changes in the "demand for expressive activities rather than with changes in fees, the law, or other policy variables."[64] They also found a "negative and highly significant effect of registration fees" on registrations and observed that the number of registrations is "highly responsive to expected commercial life of a work."[65]

With respect to legal changes, Landes and Posner found that only two of the five legal changes examined—the 1976 Copyright Act

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61. *See* Raymond Shih Ray Ku, *The Creative Destruction of Copyright:* Napster *and the New Economics of Digital Technology*, 69 U. CHI. L. REV. 263, 267 (2002) (arguing that copyright was traditionally "necessary to provide financial incentives for both creation and distribution"); Raymond Shih Ray Ku, *Consumers and Creative Destruction: Fair Use Beyond Market Failure*, 18 BERKELEY TECH. L.J. 539, 564–65 (2003) ("[C]opyright is a legal mechanism for ensuring that consumers of those works internalize the costs of their creation and distribution.").

62. Ku, *supra* note 42, at 1251–59.

63. LANDES & POSNER, *supra* note 13, at 234–49.

64. *Id.* at 245.

65. *Id.* at 245–46.

and 1988 Berne Convention—had statistically significant effects on registrations.[66] They estimated that the Berne Convention was associated with approximately a 10 percent increase in registrations.[67] As for the 1976 Copyright Act, the authors initially found that the legal change reduced the number of registrations by about 14 percent.[68] However, after discounting for a sharp drop in total registrations the year after the 1976 Act took effect, the authors estimated a 16 percent increase in registrations associated with the Act.[69] While their study found that statutory changes regarding term extension were positively associated with total applications, the results were statistically insignificant, and the authors concluded that this was consistent with the fact that the expected commercial life of a copyrighted work is "much shorter than the copyright term."[70] Finally, the study included year as a time trend variable.[71] As such, the year variable would "pick up increases in population, income, wealth, and education that are positively correlated with time . . . ."[72] In so doing, they found that year is positively correlated with registrations.[73]

Two related studies also empirically examined the effect of changes in copyright law.[74] In the first of these studies, Baker and Cunningham examined the impact of copyright law changes by looking at how quarterly changes to the breadth of copyright affected the market valuation of business equity from 1985 to 1998.[75] Baker and Cunningham relied upon U.S. Court of Appeals and Supreme Court decisions and statutory changes.[76] The authors constructed a logarithmic model and found that both statutory changes and court decisions were associated with an increase in equity returns.[77] They also found that statutory changes and Supreme Court decisions had

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66. *Id.* at 247.

67. *Id.*

68. *Id.*

69. *Id.*

70. *Id.*

71. *Id.* at 246.

72. *Id.* at 245.

73. *Id.*

74. *See* Matthew J. Baker & Brendan M. Cunningham, *Court Decisions and Equity Markets: Estimating the Value of Copyright Protection*, 49 J.L. & ECON. 567 (measuring how changes in copyright protection affect the market valuation of firm equity); Matthew J. Baker & Brendan M. Cunningham, *Law and Innovation in Copyright Industries*, 6(1) REV. ECON. RES. ON COPYRIGHT ISSUES 61 (measuring how changes in copyright protection affect total registrations), *available at* http://ssrn.com/abstract=1436160.

75. Baker & Cunningham, *Court Decisions and Equity Markets, supra* note 74, at 571.

76. *Id.* at 567, 571–72.

77. *Id.* at 567, 582–83.

larger impacts on firm equity than lower court decisions.[78] Moreover, Baker and Cunningham discerned that legal changes broadening copyright protection were associated with increases in firm equity, while legal changes narrowing copyright protection were associated with decreases in firm equity.[79] In other words, changes in copyright law impacted the public's valuation of firms that relied upon copyright law.

More importantly for this analysis, Baker and Cunningham's next study examined whether these legal changes impacted quarterly copyright applications in both the United States and Canada from 1985 to 2005.[80] In this analysis, they relied upon a linear model[81] that included legal changes among other variables—such as the growth rate of real growth domestic product ("GDP"), the openness of markets (calculated as exports plus imports divided by GDP), population, expected and real application fees, the number of Internet subscribers per thousand, the number of personal computers per thousand, and a variable capturing the relationship between personal computers and Internet subscribers.[82] With respect to statutory changes, the authors examined the contemporaneous and lagged values of the net number of statutes broadening copyright protection.[83] When that variable was added to the analysis, the authors found "no strong evidence that statutory changes significantly impact the flow of applications."[84] With respect to changes in case law, Baker and Cunningham examined the contemporaneous and lagged values of the net number of court decisions broadening copyright.[85] They found the coefficient on contemporaneous value of cases to be "small, negative, and insignificant" even though "copyright applications increase[d] by approximately 370 one quarter after a high court decision strengthen[ed] copyright protection."[86] However, when the authors examined the impact of changes in the case law utilizing an Ordinary Least Squares ("OLS") estimator for the United States alone, they found no statistically significant relationship between any legal

78. *Id.* at 582–84.

79. *Id. at* 567, 582–84.

80. Baker & Cunningham, *Law and Innovation in Copyright Industries, supra* note 74, at 61–63, 67–68.

81. As shown in Chart 3 and our nonparametric regression analyses in Appendix 1, a single linear model does not fit our data well.

82. Baker & Cunningham, *Law and Innovation in Copyright Industries, supra* note 74, at 70–74.

83. *Id.* at 75–76.

84. *Id.* at 76.

85. *Id.* at 77.

86. *Id.*

changes and copyright applications.[87] Furthermore, like Landes and Posner, Baker and Cunningham also found that increases in application fees were associated with a decrease in copyright applications.[88]

In the other study to examine changes in copyright law using empirical methods, Png and Wang examined the relationship between copyright duration and the production of motion pictures.[89] In that study, the authors examined the number of movies produced in twenty-six countries, nineteen of which extended the length of copyright protection from the author's life plus fifty years to the author's life plus seventy years at various times between 1991 and 2002.[90] The authors constructed an OLS regression model with the dependent variable as the number of movies produced in that country per year based upon information available in the Internet Movie Database.[91] The authors also included other independent variables in the regression, such as changes to copyright duration, GDP per capita, population, a time trend, country fixed effects, and copyright piracy.[92] Based upon their analysis, Png and Wang concluded that extending the term of copyright was associated with a statistically significant increase in movie production and that the increase was higher in countries where piracy was lower.[93]

Accordingly, the existing efforts to examine the question of whether copyright law promotes creativity have been limited in scope. Landes and Posner examined only five legal changes. Baker and Cunningham examined only a twenty-year time period. Moreover, both of these studies examined the impact of legal changes upon total registrations—a number that includes copyright renewals—rather than for each separate category of work. The studies treat registrations as essentially the same despite the 1988 Berne Implementation Act and other major changes to copyright registration rules. As discussed below, the parameters of these studies leave open the possibility that the statistical models do not fully capture the relationship between law and the development of creative works. While Png and Wang avoided the difficulties of conflating registrations and renewals by relying upon the Internet Movie

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87. *Id.* at 80.

88. *Id.* at 76, 80.

89. Ivan P.L. Png & Qiu-Hong Wang, Copyright Duration and the Supply of Creative Work 1 (Sept. 2006), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=932161.

90. *Id.* at 6–7.

91. *Id.* at 9.

92. *Id.* at 9–12.

93. *Id.* at 3.

Database, their study is limited to motion pictures and copyright term extension. Moreover, the authors themselves admitted that their findings were contrary to the received wisdom as evidenced in part by the studies conducted by Landes and Posner and Baker and Cunningham.[94] Consequently, the relationship between changes in copyright law and the creation of new works demands further analysis.

IV. OUR STUDY

A. Methodology

To examine the relationship between law and human creativity, we used U.S. copyright registrations as the dependent variable and as a proxy for new works created in a given year. These registrations are published annually by the U.S. Copyright Office and are available by subject matter from 1870 to the present.[95] Copyright registrations are merely proxies for works of authorship such as stories, poems, songs, pictures, and videos for two basic reasons. First, registration is not a prerequisite for obtaining copyright protection. Accordingly, authors who may intend to protect their works under copyright law may nonetheless choose not to register their works. Registration is not a costless process, and the registration fee itself—currently $65 for paper filing and $35 for electronic filing—may deter individuals from filing a registration.[96] Second, not all authors create with the intention or even the aspiration to prevent others from copying their work. As such, there is a large and unknown number of creative works that exist entirely outside of copyright law and are not represented by copyright registrations.

Nonetheless, copyright registrations are useful proxies for this analysis for two reasons. First, while registration is not required to have one's work fall under the auspices of copyright law, registration has its advantages. The most important of these is that until 1989, registration was a prerequisite to filing a copyright infringement lawsuit.[97] Specifically, registration was required before the alleged

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94. *Id.* at 3–5.

95. *See* U.S. COPYRIGHT OFFICE, CIRCULAR NO. 23, THE COPYRIGHT CARD CATALOGUE AND THE ONLINE FILES OF THE COPYRIGHT OFFICE 3, 4 (2009), *available at* http://www.copyright.gov/circs/circ23.pdf (describing access to copyright office records by date and subject matter).

96. U.S. COPYRIGHT OFFICE, CIRCULAR NO. 4, COPYRIGHT OFFICE FEES 6 (2009), *available at* http://www.copyright.gov/circs/circ04.pdf.

97. 17 U.S.C. § 411 (2006).

infringement or within three months of first publication.[98] As such, until 1989 anyone hoping to preserve a legal remedy for copyright infringement was required to register. This rule still applies for U.S. works.[99] Timely registration is also required if the copyright owner wishes to seek statutory damages or attorney's fees.[100] Otherwise, the copyright owner is limited to actual damages, which in some instances are not worth the cost of litigation. A certificate of registration also serves as prima facie evidence both that the copyrighted work is original and that the facts stated in the certificate are true.[101] Registration also entitles the owner to file with the U.S. Customs Service for protection against infringing imports.[102]

Second, while registered works do not encompass the entire universe of creative works, they represent the authors and types of works that should be most sensitive to changes in copyright law. In other words, while there are authors who may not be concerned with copyright law—that is, whose behavior may not be affected by changes in the law—those interested in benefiting from the full scope of copyright law and those at the margin (whose decisions would be influenced by changes to copyright law) should be represented by those who register their works. In short, registrants care about copyright. Consequently, if there is a group of authors or investors that would be especially responsive to changes in copyright law, it should be those who register.[103]

For the purposes of this study, we examined individual categories of copyright registrations rather than total registrations. Total registrations are unreliable because variations in aggregate copyright registrations may be influenced by changes unrelated to the scope of copyright protection. For example, the total number of registrations is influenced by the addition of new categories of copyrighted works, such as the addition of motion pictures, sound recordings, and computer programs. Total registrations also include

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98. *Id.* §§ 408–412; *see also* 2 MELVILLE B. NIMMER & DAVID NIMMER, NIMMER ON COPYRIGHT § 7.16 (2009) (discussing the significance of registration as a condition to an infringement action).

99.   17 U.S.C. § 411(a).

100. *Id.* § 412.

101. *Id.* § 410.

102. *Id.* § 602(b).

103. This is not to say that other authors would not be concerned or impacted by copyright law. To the extent that Congress and courts expand the scope of copyright, even authors who do not seek copyright protection for their own works—either because they do not wish to commercially exploit those works or because they do not desire to exclude others from using those works—are and should be concerned because they may be the targets of copyright litigation to the extent that their works are based upon, use, or even reference other works.

renewal registrations, which do not represent new works and also reflect the subsequent elimination of the requirement to file renewal registrations for works subject to dual copyright terms. While we collected data and analyzed every category of copyrighted work collected by the copyright office, this Article reports our results for six categories of copyright registrations—monographs, serials, performing arts,[104] visual arts,[105] sound recordings, and motion pictures. We report these six categories because our findings with regard to these categories are representative of the broad range of copyright works.

With respect to performing arts and visual arts, a change in how the Copyright Office categorized registrations forced us to combine formerly separate categories of works. In 1978, the Copyright Office grouped several previously separate categories—including motion pictures, musical compositions, and sculptures—into the broader categories of performing arts and visual arts. As such, we were unable to obtain specific registration numbers for individual works such as motion pictures because they are now subsumed into the broader categories. Nevertheless, we decided in favor of analyzing the umbrella categories in order to examine the influence of our independent variables over a longer period of time. However, because we are using umbrella categories, they are not entirely immune from changes brought about by the addition of new subcategories of works. As a reliability check, we report motion pictures separately, though we do so for a shorter time period.

Moreover, because the Berne Implementation Act changed the importance of registering non-U.S. works, we divided our analysis into two time periods, each of which represents a separate registration regime. In addition to the actual legal change, the choice of 1989 as the relevant demarcation was confirmed by a statistical change point analysis that tests the existence of change points and estimates the locations of any that exist. Accordingly, with respect to monographs, serials, performing arts, and visual arts we examined the impact of the independent variables in two separate time periods: 1870 to 1989 and 1989 to 2006. This separate analysis allowed us to distinguish

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104. The Copyright Office defines "performing arts works" as works intended to be "performed" directly before an audience or indirectly "by means of any device or process." Included are "(1) musical works, including any accompanying words; (2) dramatic works, such as scripts, including any accompanying music; (3) pantomimes and choreographic works; and (4) motion pictures and other audiovisual works." U.S. Copyright Office, Form PA (2006), *available at* http://www.copyright.gov/forms/formgr_pa.pdf.

105. The Copyright Office defines visual arts as pictorial, graphic, or sculptural works, including two-dimensional and three-dimensional works of fine, graphic, and applied art. 17 U.S.C. § 101 (2006).

between changes in registration rules and changes due to the scope of copyright.

In order to determine whether changes in copyright registration were influenced by changes in copyright law, we compiled a table of both legislative enactments and Supreme Court decisions that altered copyright protection. These include the recognition of new rights (including the right to control derivative works), new penalties (like the addition of criminal liability), and increases in copyright terms. These legal changes are listed by year in Appendix 2. We chose not to include lower court decisions for several reasons.[106] First, such decisions are generally limited in their geographical reach. Second, we considered it unlikely that individuals beyond the parties themselves would be sufficiently aware of such decisions for such decisions to influence their behavior. Third, the relative number and frequency of such decisions per year create dimensionality issues that mask the important factors like major legal changes or other variables that change each year. In addition to legal changes, we simultaneously examined other independent variables, including changes in copyright registration fees, population,[107] real GDP (to measure the size of the economy), and technological milestones. The list of technological milestones by year appears in Appendix 3. With respect to legal changes and technological milestones, we considered their contemporaneous and lagged associations for one, two, and three years. Ultimately, after testing one-, two-, and three-year lags, we concluded that a one-year lag more accurately reflected the time frame in which a would-be registrant would respond to these changes.

In our statistical analyses, we found many legal and technology variables (coded as dummy variables) to be statistically insignificant and therefore nuisance covariates. Too many nuisance covariates may crowd out statistical significance.[108] To see how this large number of

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106. We did include one circuit court decision, *Nichols v. Universal Pictures*, 45 F.2d 119 (2d. Cir. 1930), in this framework because of its overall importance to copyright doctrine.

107. Actually, we also considered the time trend, i.e. the year variable in our study, as Landes and Poser did. *See* LANDES & POSNER, *supra* note 13. However, it was obvious from the data that the population size and the year had almost a perfect linear relationship except for a tiny dent around 1940 corresponding to World War II. Hence the population and year variables are statistically multi-collinear and only one of them should be entered in a sensible regression analysis. We therefore retained population in our study since it makes more sense as an independent variable, but will be mindful about the association of population and year in our interpretation of statistical results.

108. Peng Liu, Jiayang Sun, & Zhongfa Zhang, *SPCA - A New Feature Selection Procedure for Large-p Data, in* 2007 PROCEEDINGS OF AMERICAN STATISTICAL ASSOCIATION, SECTION ON STATISTICAL COMPUTING (American Statistical Association CD-ROM); Debashis Paul, Eric Bair, Trevor Hastie, & Robert Tibshirani, *Preconditioning for Feature Selection and Regression in High-dimensional Problems,* 36 ANNALS STAT. 1595–1618 (2008).

dummy variables was affecting our results, we conducted simulation experiments to observe the effects of the legal and technology nuisance dummy variables (coded as "1" continuously after a year from its onset time) as the number of the dummy variables increased. For the models that are similar to ours in sample size, dimension, and structure, the truly significant dummy variables were found extremely significant, while some nuisance dummy variables were slightly significant (i.e., with p-values less than 0.05 but quite bigger than those truly significant ones) or marginally significant (i.e., with a p-value between 0.05 and 0.15). This confirms that our analyses are conservative (i.e., the significant variables will be found significant) and that most legal changes do not have their expected outcomes because the legal variables found to be significant in our study (including the marginally significant ones) only constitute a subset of all legal and technology changes.

Finally, in conducting our analysis we considered three statistical models in each of the time periods separated by the change point 1989:[109] general linear, logarithmic linear, and nonparametric.[110] For both the linear and logarithmic linear models, we were able to code legal changes and technological milestones as standard dummy variables, and as discussed above, we considered the contemporaneous and lagged association between these variables and copyright registrations. For our multiple regression analysis, the logarithmic model represented the closest fit. For the nonparametric model, we relied upon our calculated simultaneous confidence bounds of registration as a function of population as well as legal changes that expanded and decreased the scope of copyright protection. While the nonparametric model does not suffer a possible model misspecification like the parametric model and provides the best fit with regard to the relationship between copyright registrations and population, the relationship between legal changes and creativity is comparable across all three models. Moreover, the parametric model is easier to interpret. Between the two parametric models, our fitted logarithmic linear model is closer to the nonparametric fit than the linear model. Thus, the findings reported below are based upon the best logarithmic linear model.

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109. We reiterate here the importance of analyzing the monograph, serials, performing arts, visual arts, and sound recording registration data in two separate time periods, pre- and post-1989.

110. A detailed discussion of our statistical methodology is attached as Appendix 1.

B. Findings

This study tested two hypotheses. The major hypothesis is that legal changes in copyright protection will affect the number of works produced. The minor hypothesis focuses upon the relationship between these changes: increasing copyright protection will increase the number of works produced, and decreasing copyright protection will reduce the number of works produced at least until an optimal level of copyright protection is reached. As we demonstrate below, we found little empirical support for either the major or minor hypothesis. While we find found significant association between some individual legal changes and certain categories of works, many did not have any association. Hence the significance of an association is not predictable or uniform across legal changes or across works as predicted by the major hypothesis. With respect to the minor hypothesis, there was no consistent directional relationship between the number of works registered and the legal changes associated with subsequent changes in copyright registrations, as predicted by advocates of expansive copyright law. This conclusion held true not only for individual legal changes but for categories of legal changes as well—including extending the length of copyright protection, increasing civil and criminal penalties, changing the subject matter of copyright, and generally restricting copyright. Instead, we found that the number of works produced is mainly a function of population, and—in the case of monographs and serials—a function of the economy as well.

Chart 4 graphically illustrates the results of our multiple regression analysis based upon an "optimal" log-transformed model.[111] The coefficients have been transformed back into the individual legal changes' percentage influences on registrations by category. In other words, this chart illustrates the estimated influence of each legal change in consideration of the concurrent influences of other variables, including changes induced by other laws and non-legal factors like population, the economy, and registration fees. Years in which there are no bars represent legal changes that did not yield a statistically significant relationship with any of the categories of works we studied. The years in bold are those in which the legal change limited or reduced copyright protection, and the years in bold

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111. The nonparametric results for each of the categories as well as for overall registrations can be found in Appendix 1. We also created linear and quadratic models, but concluded that the log-transformed model was the best fitting parametric model.

and underlined represent years in which legal changes both increased and decreased copyright protection.[112]

CHART 4. PERCENTAGE CHANGE IN COPYRIGHT REGISTRATION CAUSED BY LEGAL CHANGES

Changes in Copyright Law & Registrations

Percentage Change in Registrations

-40	-20	0	20	40	60	80	100

Years with Changes in Copyright Law

1870
1879 — 1879
1884 — 1884
1886 — 1886
1886 — 1886
1891
1897 — 1897
1902 — 1902
1903 — 1903
1908
1909
1909
1912 — 1912
1917
1919
1930 — 1930
1939
1941
1952 — 1952
1954
1962
1964
1971 — 1971
1973 — 1973
1974
1976 — 1976
1980 1980
1982 — 1982 — 1982
1984 — **1984**
1985
1986
1988 — 1988
1989
1990 — 1990
1991 — 1991
1992
1994 — **1994**
1995 — 1995
1997 — 1997
1998 — 1998
1999
2001 — 2001
2002
2003 — 2003
2005

■ Monographs   □ Performing Arts   ▪ Motion Pictures   ■ Sound Recordings   ▣ Serials

112. For the purposes of this analysis, we did not include two changes in registration associated with the 1870 legal change. These associations were so high—a 100 percent reduction in the case of serials—that we considered them to be an unreliable byproduct of being so closely associated with the starting/intercept point for the model.

1. By Work

With regard to books registered between 1870 and 1989, we found that only six legal changes out of a possible twenty-nine had a statistically significant connection to changes in the number of works subsequently registered.[113] In other words, 21 percent of the legal changes during this time period significantly contributed to changes in the number of new works. From 1989 to 2006, our research revealed that only five legal changes out of a possible thirteen (46 percent) had a statistically significant contribution.[114] Overall, 29 percent of legal changes bore a measurable contribution to the number of new books created when all other possible influential factors were taken into consideration. Registrations fees did not have a statistically significant association in either time period. In addition to these legal changes, population and GDP were statistically significant influences—with population as the most dominant variable. Growth in population was consistently associated with increases in the number of new books. Meanwhile, growth in GDP was positively associated with new books registered between 1870 and 1989, but it was negatively associated after 1989. This indicates that the Berne Implementation Act had a profound influence on registrations after 1989.[115]

The largest increase in book registrations (35 percent increase) was associated with the 1997 No Electronic Theft Act, which provided for criminal liability even when the infringer did not seek financial gain. That Act was passed in response the electronic distribution of computer software, which could be registered as a monograph. It was followed closely by the Supreme Court's decision in *Eldred v. Ashcroft*. That case, which upheld Congress's decision to increase the length of copyright protection, provided the second-largest increase in book registrations (34 percent increase). The largest decrease of monograph registrations (27 percent decrease) was associated with three legal changes occurring in 1990: the Visual Artists Rights Act, the

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113. App. 1, tbl.1.

114. App. 1, tbl.2.

115. The negative value is the contribution of GDP to the *remaining unexplained variation* in the number of registered works after the contributions by other factors have been counted. Indeed, as shown by the data, population and GDP were positively correlated. The growth in each, when each acted alone, would have positive association with the growth of new works. However, population and GDP did not grow in isolation. When the contribution or association of population had been counted, the contribution of GDP to registered works had already been partially counted; the coefficient for the GDP provided an additional contribution or association (if it had the same sign as the simple regression) or an adjustment (if it had a different sign) to what is already explained by other factors.

Architectural Works Copyright Protection Act, and the Supreme Court's decision regarding copyright renewal in *Stewart v. Abend.*[116] The next largest decline in book registrations (26 percent decrease) was associated with the 1909 Act.[117] With thirteen associated legal changes, books were the most sensitive category of copyrighted works in our study.

With regard to serials, we found statistically significant associations between population, GDP, and registration fees and subsequent serial registrations—though the direction of these associations varied. From 1870 to 1989, population growth was associated with an increase in the number of new serials,[118] but from 1989 to 2006, the regression coefficient for population was negative as an adjustment factor.[119] The regression coefficient for GDP was negative from 1870 to 1989 but had no statistically significant relationship after 1989. Registration fees were negatively associated with the number of registrations before 1989, but they had no statistically significant relationship after 1989. From 1870 to 1989, we found seven out of a possible twenty-nine legal changes (24 percent) to have a statistically significant connection to the number of works subsequently registered. From 1989 to 2006, we found three legal changes out of a possible thirteen (23 percent) to have such a relationship.

The two largest increases to serial registrations (30 percent increases) were associated with legal changes in 1994 and 2003. The year 1994 included both an international agreement extending copyright to protect live musical performances as well as a U.S. Supreme Court decision recognizing parody as a potential fair use of copyrighted works. In 2003, the U.S. Supreme Court upheld the extension of the length of copyright protection. The largest decrease in serial registrations (18 percent decrease) followed the Second Circuit's decision in *Nichols v. Universal Pictures Corp.,* which recognized the importance of protecting copyrighted works beyond literal copying.[120] These results reaffirm our theory that the Berne Implementation Act made a sharp change that either slowed down the increase of registered works or actually made the number of registrations decrease. The effects of significant legal changes both before and after

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116. Visual Artists Rights Act of 1990, 17 U.S.C. § 106A (2006); Architectural Works Copyright Protection Act, 17 U.S.C. § 102 *et seq.*; Stewart v. Abend, 495 U.S. 207 (1990).

117. Copyright Act of 1909, ch. 320, 35. Stat. 1075 (1970) (current version at 17 U.S.C. §§ 101–805 (2006)).

118. App. 1, tbl.3.

119. App. 1, tbl.4.

120. Nichols v. Universal Pictures Corp., 45 F. 2d 119 (2d Cir. 1930).

1989 on the number of copyright registrations are tiny in comparison to the effects of the population or the time trend.

With regard to the performing arts, between 1870 and 1989, we found that ten legal changes out of a possible twenty-nine (34 percent) had a statistically significant relationship to the number of new works subsequently registered,[121] and one legal change out of a potential thirteen (8 percent) had a statistically significant association between 1989 and 2006.[122] Overall, a little more than one-in-four legal changes were related to the number of new works of performing arts registered. Population was an important—if not the dominant—variable before 1989, although it had no measurable relationship after 1989. GDP and registration fees were not statistically relevant in either time period. The largest increase of performing arts registrations (33 percent increase) was associated with the Supreme Court's 1879 decision limiting copyright to the protection of expression and not ideas.[123] The next two largest increases of performing arts registrations (24 percent increases) were associated with the extension of recording and performing rights to non-dramatic literary works in 1952 and with the United States' joining the Berne Convention and the Satellite Home Viewing Act in 1988. Decreases in performing arts registrations were associated with the protection of motion pictures in 1912 (13 percent decrease) and the Supreme Court's decision requiring copyrighted works to have at least a minimal degree of creativity (24 percent decrease).[124]

While motion pictures are generally treated as a subcategory of performing arts due to the Copyright Office's registration policies, we obtained motion picture-specific data between 1913 and 1983. During that time period, we found three out of fifteen legal changes (20 percent) had a statistically significant relationship to new copyright registrations.[125] Motion picture registrations were also positively associated with growth in population and negatively correlated with increases in registration fees. The 1930 legal change in *Nichols*[126] was associated with a 31 percent decrease in registrations, the largest decrease in our study. The 1971 legal change was the largest increase in registrations in our study; it was associated with a 47 percent increase in motion picture registrations. In that year, the United

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121. App. 1, tbl.5.
122. App. 1, tbl.6.
123. *In re* Trade-Mark Cases, 100 U.S. 82, 91–99 (1879).
124. Feist Publ'ns, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 345 (1991).
125. App. 1, tbl.7.
126. 45 F.2d 119 (2d Cir. 1930).

States protected sound recordings and participated in the revision of the Universal Copyright Convention, which strengthened international protection for copyrighted works. The Copyright Act of 1976 was associated with a 28 percent increase in motion picture registrations.[127]

Finally, with regard to sound recordings, which only became eligible for copyright protection in 1972, we found four out of twenty-two legal changes (14 percent) had a statistically significant association with subsequent sound recording registrations through 2006.[128] Two of these occurred before 1989, and two occurred after 1989. Population was positively associated with new sound recordings before 1989, but it was not statistically relevant afterwards. Registration fees were positively associated with sound recording registrations before 1989, but they were not statistically relevant afterwards. GDP was not statistically relevant in either time period. The Supreme Court's decision upholding Congress's increase of the length of copyright protection[129] was associated with the largest increase in sound recording registrations (36 percent increase). Congress's increase of criminal penalties[130] was associated with the second-largest increase in sound recording registrations (33 percent increase). The year including the passage of both the Copyright Term Extension Act ("CTEA") and the Digital Millennium Copyright Act[131] ("DMCA") was associated with a 23 percent increase in sound recording registrations. Both the Berne Implementation Act and the Satellite Home Viewer Act were associated with an 18 percent decrease in sound recording registrations. Both motion pictures and sound recordings appeared to be less sensitive to legal changes than the other works in this study.[132]

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127. Copyright Act of 1976, Pub. L. No. 94-553, 90 Stat. 2541 (codified as amended at 17 U.S.C. §§ 101–810 (2006)).

128. App. 1, tbls.8–9.

129. Eldred v. Ashcroft, 537 U.S. 186 (2003).

130. Prioritizing Resources & Organization for Intellectual Property (PRO-IP) Act of 2008, Pub. L. No. 110-403, 122 Stat. 4256 (to be codified in scattered sections of 15, 17, 18, 19, 42 U.S.C.).

131. Sonny Bono Copyright Term Extension Act (Copyright Term Extension Act) (CTEA), Pub. L. No. 105-298, 112 Stat. 2827 (1998); Digital Millenium Copyright Act (DMCA), Pub. L. No. 105-304, 112 Stat. 2860 (1998).

132. Because the distribution of visual arts registrations did not fit a parametric model (i.e., linear, quadratic, or log transformed), we did not conduct a multiple regression analysis measuring the association between legal changes and technological milestones upon those registrations using those models. Our nonparametric results suggest that following an initial bump in registrations most likely due to the practice of copyrighting individual frames of motion pictures, which was common until motion pictures were entitled to their own separate protection,

2. Across Categories

The lack of consistency and uniformity between changes in copyright law and copyright registrations also exists when legal changes are considered across categories. Overall, the relationship between legal changes and new registrations increased when we examined whether a legal change was associated with at least one category of work. Twenty-four out of forty-two legal changes had at least one such association. In other words, a little more than half of all legal changes had a statistically significant association with a subsequent change in copyright registrations. However, these associations occurred 24 percent of the time when all of the individual categories of works were considered.[133] Of those relationships, twenty-seven were positive and thirteen negative. Given these results, legal changes have been historically associated with an increase in at least one category of registrations 41 percent of the time. This number fell to 38 percent when only laws expanding copyright protection were considered. Not a single legal change between 1870 and 2006 had a statistically significant association across all of the categories studied.

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visual art registrations are consistent with the other categories in this study, with population being the most important variable. *See* App. 1.

133. Some may question this analysis because the denominator includes all of the categories of works in our study. In some cases, we may not expect a relationship as a legal change may be directed towards a specific category of work, such as the addition of motion pictures as a category of protected work, treating computer software as literary works, or the regulation of live musical performances. One might suggest that such legal changes should not influence other creative works. I would like to thank Justin Hughes for raising this point. We chose not to limit our analysis on the assumption that category-specific legal changes should only be analyzed for that category. First, it is possible that changes in protection for one kind of work may impact the investment and time spent on other works. If so, we wanted to be able to examine that crossover effect. Consider the 1912 addition of motion pictures to the category of works protected by copyright. One might argue that we should limit our analysis of that legal change to motion picture registrations because it is only directly relevant to motion pictures. However, this position ignores the fact that changes with regard to one type of creative work may have indirect consequences, both positive and negative, for other copyrighted works. For example, protecting motion pictures may very well encourage more people to write books and short stories let alone screenplays to provide the story for motion pictures. Moreover, the advent of sound in motion pictures may encourage people to write and perform more music. However, the addition of motion pictures may also hurt music and other performing arts by competing for the public's limited time and dollars. Second, a more narrow focus would ignore the signaling aspects of legal changes. In other words, a song writer may be encouraged to write more songs as a result of Congress's decision to protect motion pictures because it signals the importance of copyright in general, or simply because the songwriter might expect similar favorable treatment in the future. If we had limited our analysis to motion pictures, we would have missed the statistically significant association with books, serials, and works of performing arts.

3. By Type of Legal Change

When we organized legal changes into subcategories, a slightly different picture appeared. We grouped legal changes into those that increased the length of copyright protection, expanded the subject matter capable of being copyrighted, recognized new rights for copyrighted works, increased civil and criminal penalties, and reduced or otherwise limited copyright protection. Because our variable for legal change was the year in which the change occurred, we were unable to isolate the effects of any given legal change when more than one change occurred in a year. As such, when different subcategories of legal changes occurred in the same year, we added that year to each subcategory.

CHART 5. LAWS INCREASING LENGTH OF COPYRIGHT PROTECTION
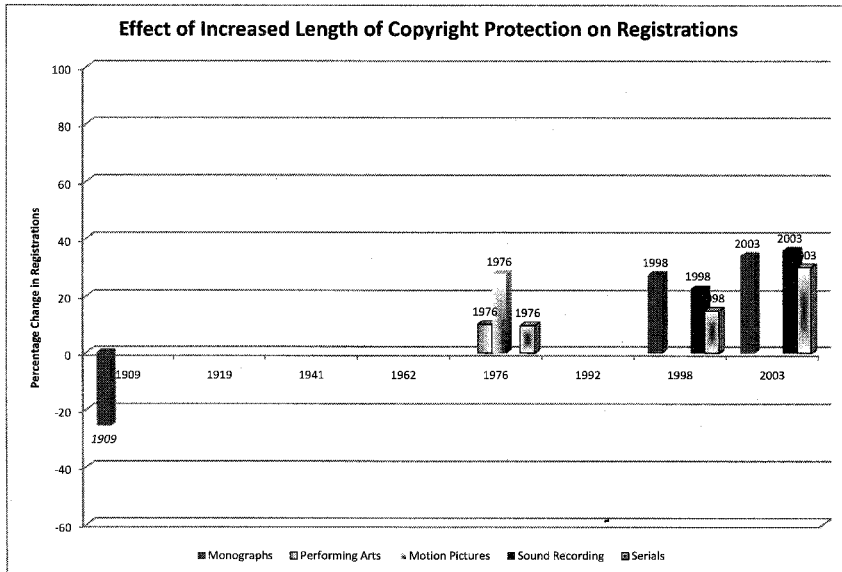
Of the eight laws changing the length of copyright protection, four (50 percent) had a statistically significant relationship with at least one category of creative works. Two of those legal changes were the major revisions of copyright law in 1909 and 1976, which did more than just increase the length of copyright protection. When all categories of registrations are considered, term changes impacted registrations 31 percent of the time. The 1909 Act was associated with a 26 percent reduction in book registrations. The 1976 Act was associated with a 10 percent increase in performing arts, 10 percent

increase in serials, and 28 percent increase in motion pictures registrations. The CTEA, passed the same year as the DMCA,[134] was associated with a 27 percent increase in monograph, 15 percent increase in serial, and 23 percent increase in sound recording registrations. The Supreme Court's 2003 decision in *Eldred*[135] was associated with a 34 percent increase in monograph, 30 percent increase in serial, and 36 percent increase in sound recording registrations. Accordingly, laws increasing copyright protection had a 45 percent probability of increasing registrations in at least one category and a 5 percent probability of decreasing registrations in at least one category.

CHART 6. LAWS GRANTING NEW RIGHTS
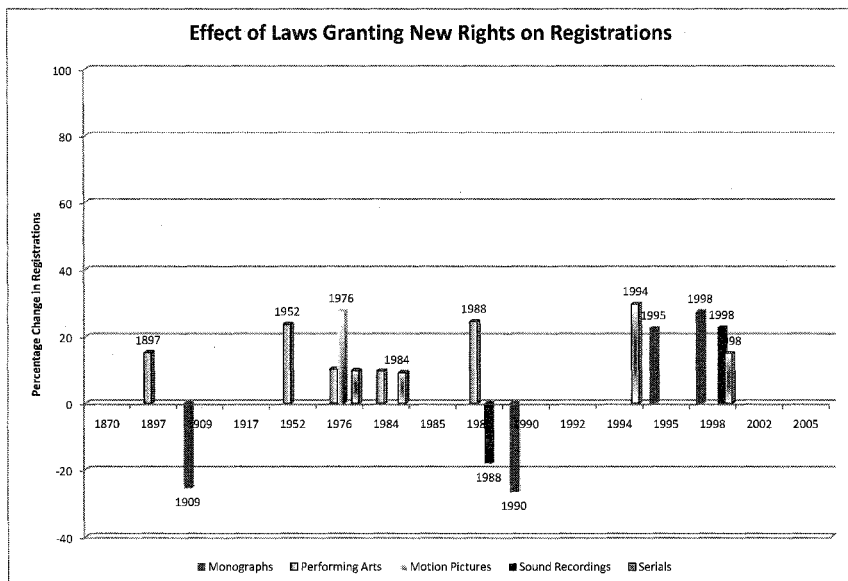
Of the fifteen laws that increased the legal rights available to copyright owners, such as the right to control derivative works or to publicly display works, ten were associated with changes in registrations for at least one category of work.[136] In other words, 67 percent of legal changes that gave copyright owners a new right had a statistically significant association with at least one category of work. This figured dropped to 27 percent when all categories were

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134. 112 Stat. 2827; 112 Stat. 2860.

135. Eldred v. Ashcroft, 537 U.S. 186 (2003).

136. Again, we excluded the 1870 revision.

considered. Of the sixteen instances in which a statistically significant association was found, thirteen were positive and three were negative. Every category of creative works exhibited at least one association with laws expanding the legal rights available under copyright. For motion pictures, the 1976 Act was associated with a 28 percent increase in registrations. For sound recordings, the CTEA and DMCA were associated with a 23 percent increase in registrations, and the Berne Implementation Act and Satellite Home Viewer Act[137] were associated with an 18 percent decrease in registrations. For books, the 1909 Act was associated with a 26 percent decrease in registrations, and the Visual Artists Rights Act ("VARA") and Architectural Works Copyright Protection Act ("AWCPA") were associated with a 27 percent decrease in registrations.

The Digital Performance Right in Sound Recordings Act was associated with a 22 percent increase in book registrations, and the CTEA and DMCA in 1998 were associated with a 27 percent increase. For performing arts, all five associations were positive. The Act of 1897 was associated with a 15 percent increase, the Act of 1952 a 24 percent increase, and the 1976 Act a 10 percent increase. A cluster of legal changes in 1984, including the Semiconductor Chip Protection Act, Record Rental Amendment, and the Supreme Court's decision in *Sony Corp. v. Universal City Studios, Inc.*,[138] was associated with a 10 percent increase. The 1988 Berne Convention Implementation Act and Satellite Home Viewer Act were associated with a 24 percent increase. Overall, laws granting copyright owners new rights over their works had a 54 percent probability of increasing registrations in at least one category of work, and they had a 13 percent probability of decreasing registrations.

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137. Berne Convention Implementation Act, Pub. L. 100-568, 102 Stat. 2853 (1988); Satellite Home Viewer Act, Pub. L. 100-667, 102 Stat. 3949 (1988).

138. Semiconductor Chip Protection Act of 1984, 17 U.S.C. §§ 901–14 (2006); Record Rental Amendment of 1984, Pub. L. No. 98-450, 98 Stat. 1727 (2006) (amending 17 U.S.C. §§ 109, 115); Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417 (1984).

CHART 7. LAWS INCREASING CIVIL/CRIMINAL PENALTIES
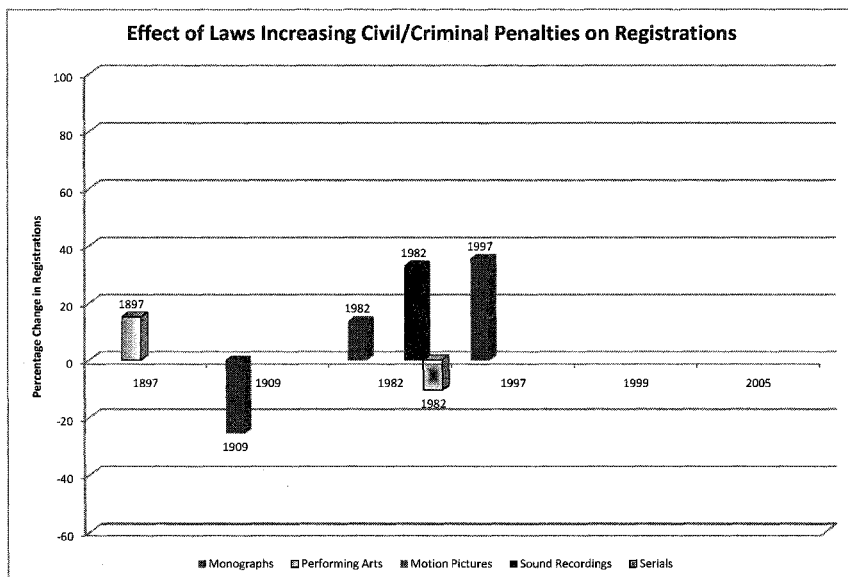
Six laws changed criminal or civil penalties, all of which created or increased penalties during the period of this study. Four of these legal changes (67 percent) correlated with at least one change in subsequent copyright registrations. However, laws increasing criminal penalties were only associated with changes in copyright registrations six out of twenty-three times (26 percent) with regard to all creative works studied. These legal changes were associated with increases in registrations in four instances: performing arts (15 percent increase), monographs twice (14 percent and 35 percent increases), and sound recordings (33 percent increase). These legal changes were also associated with two decreases in registrations for monographs (26 percent decrease) and serials (10 percent decrease). The 1982 legal change was the only one that exclusively addressed penalties, and it was associated with a change in registrations of three categories of works: books (14 percent increase), serials (10 percent decrease), and sound recordings (33 percent increase). Motion picture registrations did not exhibit any statistically significant relationship with laws increasing criminal or civil penalties. Given these results, laws increasing copyright penalties had a 44 percent probability of increasing at least one type of registration, and they had a 22 percent chance of decreasing at least one category of registrations.

CHART 8. LAWS EXPANDING COPYRIGHTABLE SUBJECT MATTER

Effect of Laws Expanding Copyrightable Subject Matter on Registrations
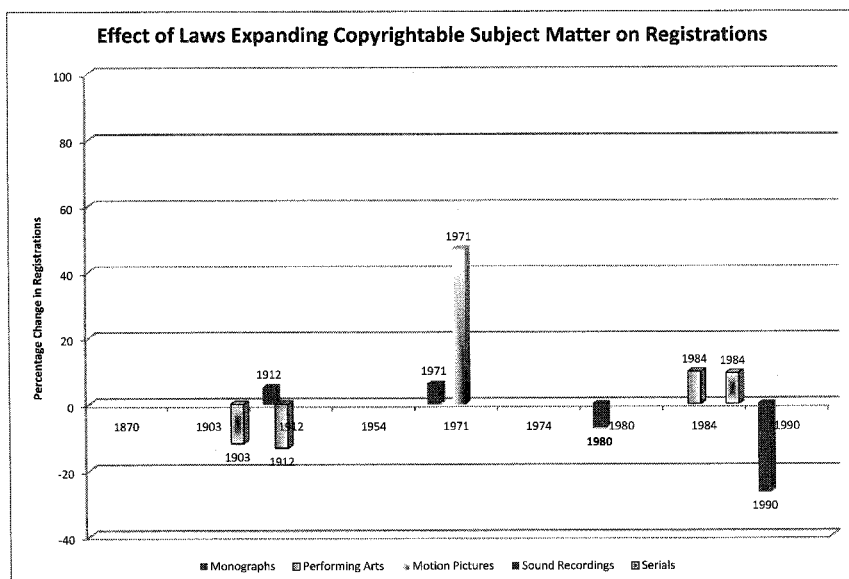
During the time period of this study, eight laws expanded the subject matter of copyright by enlarging the kinds of expression eligible for copyright protection.[139] Six of these laws (75 percent) were associated with a change in registrations in at least one category of work.[140] Subject matter legal changes affected the number of registrations of all creative works nine times out of thirty-three (27 percent). These nine changes were almost evenly split between five positive and six negative associations. The 1971 legal changes, protecting sound recordings and revising the Universal Copyright Convention,[141] produced the largest change in registrations in this category: a 47 percent increase in motion picture registrations. Monograph registrations also saw an increase of 6 percent associated with the 1971 changes. Monographs exhibited the largest decrease in registrations in the category. They witnessed a 27 percent decrease associated with the legal changes in 1990: VARA, AWCPA, and *Stewart v. Abend.*[142] The Supreme Court's decision protecting

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139. The 1870 revision would fall under this category, but once again, we are excluding it for statistical purposes.

140. App. 1, tbl.16.

141. *See* App. 1, tbl.17.

142. Visual Artists Rights Act of 1990, Pub. L. 101-650, 104 Stat. 5089, 5128 (2006); Architectural Works Copyright Protection Act of 1990, Pub. L. 101-650, 104 Stat. 5089, 5133 (2006); Stewart v. Abend, 495 U.S. 207 (1990).

advertisements based upon the principle of nondiscrimination[143] was associated with a 12 percent decrease in serial registrations. The extension of copyright to protect motion pictures resulted in a 5 percent increase in monograph registrations and a 13 percent decrease in performing arts registrations. Counterintuitively, the 1980 legal change—protecting computer software as a literary work[144]—was associated with a 7 percent decrease in the registration of monographs. Moreover, the protection of semiconductor chips, the regulation of record rentals, and the Supreme Court's 1984 *Betamax* decision[145] were associated with a 9 percent increase in serial and 10 percent increase in performing arts registrations. As a category, only sound recordings did not exhibit any relationship with laws expanding copyrightable subject matter. According to the data, there was a 42 percent probability that a law expanding the subject matter of copyright would increase registrations, and a 50 percent probability it would decrease registrations.

CHART 9. LAWS LIMITING OR REDUCING COPYRIGHT PROTECTION

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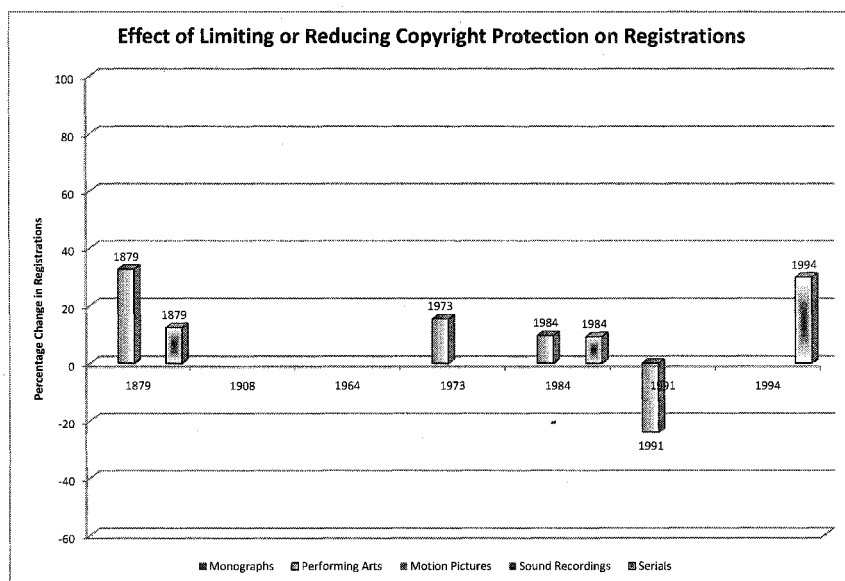
143. *Stewart*, 495 U.S. 207.

144. Computer Software Copyright Act of 1980, Pub. L. 96-517, 94 Stat. 3015 (current version at 17 U.S.C. § 117 (2006)).

145. Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417 (1984).

The most consistently positive associations were found with laws that reduced or otherwise limited copyright protection.[146] Of the seven legal changes that reduced or otherwise limited copyright protection, five (71 percent) were associated with changes in registration for at least one category of creative works. When the relationship between these legal changes was considered with respect to all categories, in seven out of a possible twenty-seven cases (26 percent) these laws had an effect. Six of those associations led to increases in registrations, and only one led to a decrease. The Supreme Court's seminal decision in 1879 establishing the idea/expression dichotomy[147] was associated with a 12 percent increase in serial registrations and a 33 percent increase in performing arts registrations. The Court's affirmance of a lower court's conclusion that photocopying scientific journal articles was fair use[148] was associated with a 15 percent increase in performing arts registrations. The protection of semiconductor chips, the regulation of record rentals, and the Court's 1984 *Betamax*[149] decision were associated with a 9 percent increase in serial and 10 percent increase in performing arts registrations. The Court's 1991 decision requiring a minimal degree of creativity for a work to be protected under copyright[150] accounted for the only decrease in registrations: a 24 percent decrease in performing arts registrations. The 1994 law providing protection of live musical performances and the Court's decision recognizing parody as fair use[151] were associated with a 30 percent increase in the registration of serials. Book, motion picture, and sound recording registrations exhibited no associations with these legal changes. Given these associations, there was a 61 percent chance that a law decreasing copyright protection would increase copyright registrations, and a 10 percent chance it would decrease registrations.

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146. App. 1, tbl.17.

147. *In re* Trade-Mark Cases, 100 U.S. 82 (1879).

148. Williams & Wilkins Co. v. United States, 420 U.S. 376 (1975).

149. *Sony Corp. of Am.*, 464 U.S. 417.

150. Feist Publ'ns, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 345 (1991).

151. Uruguay Round Agreements Act, Pub. L. No. 103-465, 108 Stat. 4809 (1994); Campbell v. Acuff-Rose Music, Inc., 510 U.S. 569, 579 (1994).

If we excluded the 1964 preemption decisions and *Feist*,[152] the percentages respectively changed to 80 percent and zero.[153]

C. Does Law Inspire Creativity?

What develops from the data is a complex picture of the relationship between changes in copyright law and the registration of new works. At the very least, our findings cast serious doubt on the idea that, with copyright law, one size fits all.[154] In other words, there is little support for the broad proposition that one may expect changes in copyright law to have a predictable and uniform effect across all creative works, whether those works are books, sound recordings, or musical compositions. Even interpreted in the light most favorable to our hypotheses, the evidence suggests that it is at best slightly better than a coin toss whether a legal change will have any effect upon a single category of creative works. The data indicate that one cannot reliably predict ex ante whether a legal change will have a positive or negative effect on the number of new works produced. In many instances, the same legal change is associated with an increase in registrations in one category and a decrease in another without any apparent substantive reason for the different outcomes. Moreover, our data suggest that laws increasing copyright protection and laws reducing copyright protection are *both* likely to be positively associated with changes in the number of new works registered.

The study demonstrates that the categories of copyrighted works differ in sensitivity to legal changes. Monographs, with twelve

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152. *Feist*, 499 U.S. at 345 (finding that a work must contain "some minimal degree of creativity" in order to qualify for copyright protection); Sears, Roebuck & Co. v. Stiffel Co., 376 U.S. 225, 228 (1964) (holding that federal patent law is "one of the enumerated powers of Congress"); Compco Corp. v. Day-Brite Lighting, Inc., 376 U.S. 234, 237 (1964) (holding that state law may not act to prevent copying of an article that is unprotected by federal patent or copyright).

153. The 1964 legal changes involved two Supreme Court decisions addressing the federal preemption of state law with regard to intellectual property claims. *See Sears, Roebuck*, 376 U.S. 225; *Compco*, 376 U.S 234. Even though these decisions have implications for copyrights because they specifically involved patent law, the lack of association with copyright registrations may not be unexpected. Likewise, the Supreme Court's decision in *Feist* differs from the other laws in this category because it does not decrease copyright protection allowing others to create new works outside the original copyright owner's control. Instead, it categorically denies protection for works lacking sufficient creativity, and could be considered sufficiently different in kind to justify separate treatment.

154. *See* Ku, *supra* note 42, at 1251–59 (arguing that incentives must be evaluated by the specific creative endeavor); *see also* Michael W. Carroll, *One for All: The Problem of Uniformity of Cost in Intellectual Property Law*, 55 AM. U. L. REV. 845, 846–47 (2006); Lydia Pallas Loren, *The Pope's Copyright? Aligning Incentives with Reality by Using Creative Motivation to Shape Copyright Protection*, 69 LA. L. REV. 1, 4 (2008).

associations, were the most sensitive. Performing arts had eleven associations; serials had ten associations. In contrast, both motion pictures and sound recordings—with three and four associations respectively—appeared less sensitive to legal changes, though these associations were also over a shorter time period than the other categories.

Our study also illustrates the varying likely outcomes based upon the type of legal change. Increasing the length of copyright protection has a 45 percent chance of increasing copyright registrations, and expanding the subject matter protected by copyright has a 42 percent chance of increasing registrations. Granting copyright owners new rights over their works has a 54 percent chance of increasing copyright registrations, while creating or increasing penalties for copyright infringement has a 67 percent chance. In contrast, laws decreasing or limiting copyright protection have either a 61 or an 80 percent chance of increasing copyright registrations, depending upon which legal changes are included in this category.

While laws increasing the length of copyright protection are less likely to increase registrations, they are also the least likely to decrease registrations (5 percent of the time). There is a 13 percent probability that increasing rights will decrease registrations, a 22 percent probability that increasing penalties will decrease registrations, and a 50 percent probability that expanding copyrightable subject matter will decrease registrations. With regard to laws decreasing copyright protection, there is either 10 percent possibility or none that such laws will decrease registrations, depending upon what legal changes are included in this category. These results indicate that laws increasing copyright terms are nine times more likely to increase registrations than to decrease them. Laws expanding rights are four times more likely to increase than decrease registrations. Increasing penalties is twice as likely to increase registrations than decrease them. However, expanding the subject matter of copyright is more likely to decrease registrations than to increase them. Lastly, decreasing copyright protection is at least six times more likely to increase registrations.

From an institutional perspective, there is very little difference between the sources of the legal change. Federal statutes are slightly more likely to be associated with a change in registrations than are Supreme Court decisions. Sixty-one percent of the federal statutes in our study were associated with at least one change in registration, compared to fifty-eight percent of Supreme Court decisions. Likewise federal statutes were slightly more consistent: they exhibited a 26 percent association across all categories, compared to 22 percent for

Supreme Court decisions. These figures include years in which the Supreme Court and Congress were both responsible for legal changes. When those mixed years are excluded, Supreme Court decisions were associated with changes in the number of registrations in at least one category 57 percent of the time and across all categories 23 percent of the time. The corresponding results for statutes were 61 and 27 percent.

In addition to these general observations, four more tentative observations may be made with regard to three types of legal changes and changes to registration fees. First, laws limiting or decreasing copyright protection appear more likely and more consistently to be associated with an increase in the number of new works registered. Second, changes in the length of copyright protection appear to be the least likely to result in a statistically significant relationship to changes in the number of works registered. Third, laws expanding the subject matter protected by copyright appear to be the most likely to reduce subsequent copyright registrations. And fourth, increases in copyright registration fees are associated with a reduction in the number of new works registered, though this relationship is not constant across all categories of works.[155] While increases in registration fees were associated with a decrease in copyright registrations for serials and motion pictures, we found no statistically significant associations between registration fees and monograph or performing arts registrations. However, we did find a positive association between an increase in registration fees and sound recording registrations.

These results do not imply that individual legal changes may not influence the number of new works created. They only imply that probability and direction of change are extremely difficult to predict. Whether any given legal change will have an effect, what category of works will be affected, and whether a relationship will be positive or negative are never certain—although our data do show that any relationship is more likely to be positive, especially when the legal change decreases copyright protection. Furthermore, our results should not be interpreted to suggest that some individuals are not in fact influenced to create new works by these legal changes. The artists who testify before Congress in favor of increases in copyright protection, among others, may very well be so influenced. Our findings merely suggest that there is no statistically significant relationship in

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155. These last two observations are consistent with Landes and Posner's results with much more complete and detailed data and by subcategories rather than all copyright registration combined. *See* LANDES & POSNER, *supra* note 13, at 245–46.

the aggregate.[156] For every individual motivated to higher levels of productivity, a similar number may be deterred by the change in the law.

In the end, population is the only variable consistently associated with changes in the number of new copyright registrations. Once we controlled for the change in registration rules, growth in population was consistently associated with increases in copyright registrations for all the categories of works studied. Population as a variable is also consistently sturdier than legal changes.[157]

In their study, Landes and Posner hypothesized that the importance of population could be explained as a function of the size of the market for copyrighted works.[158] In other words, as population increases, the number of people interested in access to creative works grows. This increase in demand leads to a corresponding increase in supply.[159] While this hypothesis is certainly one possible explanation, changes in population may affect the supply side of the equation as well. In other words, a growing population may produce more artists— or, as some have more recently described it, a larger "creative class"[160]—and these artists may produce creative works regardless of the legally created incentives available or even actual market demand.[161] Accordingly, as society grows, we may find in our midst more Edgar Allan Poes[162] who are willing to create regardless of the circumstances or opportunities for success and remuneration. More likely, the relationship between population and new works is a combination of the two, with population growth expanding both the creative class and the individuals that comprise the market for

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156. A Simpson's paradox occurs when the results of subgroup studies contradict those of a combined study in which the subgroup data are lumped together. This is not statistically surprising because what happens in a subgroup may not apply to the whole group, and vice versa. In a combined study, a group's gain can be cancelled by another group's loss. *See* Stanford Encyclopedia of Philosophy, Simpson's Paradox, Aug. 6, 2009, http://plato.stanford.edu/ entries/paradox-simpson.

157. In the most extreme case—performing arts registrations—population exhibited a t-value of 178.5619 compared to the highest t-value (5.1495) for a legal change, the Supreme Court's *Burrow-Giles Lithographic Co. v. Sarony*, 111 U.S. 53 (1884), decision. App. 1, tbl.6.

158. LANDES & POSNER, *supra* note 13, at 245.

159. *Id.*

160. *See* RICHARD FLORIDA, THE RISE OF THE CREATIVE CLASS: AND HOW IT'S TRANSFORMING WORK, LEISURE, COMMUNITY, AND EVERYDAY LIFE 67–68 (2002).

161. Our conclusion is similar to Michael Kremer's work in which he determined that "an increase in population leads to an increase in technological change." Kremer, *supra* note 15, at 681. In other words, "a higher population means more potential inventors." *Id.* at 684.

162. Poe is often considered one of the first American authors to attempt to make a living as a writer and suffered great financial difficulty as a result. *See* JEFFREY MEYERS, EDGAR ALLAN POE: HIS LIFE AND LEGACY 138 (1992); ARTHUR HOBSON QUINN, EDGAR ALLAN POE: A CRITICAL BIOGRAPHY 305 (1941).

creative works. Consequently, our research suggests that there is little empirical support for the proposition that increasing copyright protection yields a greater bounty of copyrighted works. In fact, the data tentatively suggest the opposite: to the extent that legal changes matter, laws reducing copyright protection are more likely to increase the number of new copyrighted works.

In summary, our study demonstrates that the effect of legal changes on copyright registrations is neither predictable nor uniform. While individual legal changes have historically been associated with changes in copyright registrations, it is extremely difficult to predict: (1) whether any given legal change will have such an effect; (2) what category or categories of works will be affected; and (3) when there is a relationship, whether that relationship will be positive or negative. In other words, when lawmakers consider whether to expand copyright law, the most they can expect in general is a 38 percent chance that the new law will increase the number of new registrations for some unknown category of work. The likelihood changes depending upon the type of legal change at issue. The least effective strategy is to expand the subject matter of copyright, as this type of legal change is more likely to reduce registrations rather than increase them. If lawmakers wish to decrease the number of works registered, increasing copyright registration fees is more likely to produce that result. Instead, if lawmakers wish to increase the number of new works registered, the best strategy is to limit or decrease copyright protection—and even then the result is far from guaranteed.

V. WHY THE DISCONNECT?

In order to understand why changes in copyright law do not have the expected relationship with creative output, this Part explains why the principal economic model is incomplete. However, before beginning this discussion, it is important to emphasize what this study does not suggest. First, it does not suggest that copyright law has no relationship to creative production, or that the same or an even greater number of creative works would exist in a world without copyright law. Some form of copyright protection has existed in the United States since 1783,[163] and our study begins with registrations in 1870, so the existence of copyright law is a baseline for this study. Our study therefore focuses upon whether changes to that baseline relate to changes in the number of new works registered. Second, our results

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163. Benjamin W. Rudd, *Notable Dates in American Copyright: 1783–1969*, http://www. copyright.gov/history/dates.pdf (last visited Oct. 8, 2009).

do not suggest that the individuals who testified before Congress were lying or otherwise behaving in a strategic manner. It is quite possible that those individuals genuinely believed that changes in copyright law would lead to a change in their behavior. As discussed above, as a statistical matter, our findings may well represent another example of Simpson's Paradox, where the relationship between variables at the subgroup level is different from those relationships in the aggregate. For example, for every individual genuinely motivated by the new incentives, there may be an equal number deterred. In this Part, we discuss why the traditional economic model upon which our original hypotheses were based is incomplete and why even under a wealth-maximizing, rational actor model increasing copyright protection is unlikely to increase the number of new works produced.[164]

Consider the traditional economic model of copyright. In an earlier work, Landes and Posner provided this succinct description: "For a new work to be created, the expected return—typically, and we shall assume exclusively, from the sale of copies—must exceed the expected cost."[165] And the cost of creating the work "consists primarily of the author's time and effort plus the cost to the publisher of soliciting the manuscript and setting it in type."[166] Accordingly, the rational individual seeking to increase her wealth would measure these costs against the expected return. By preventing free riding, copyright law makes it possible for an author to secure the necessary expected return from a successful work. This is considered necessary because if individuals were free to copy the author's work without incurring the cost of creating the work, competition would drive down the expected return of the work to the point where the author would be unable to recoup those costs and thus would be unwilling to create the work in the first instance. As discussed above, the argument based upon this model for increasing copyright protection is essentially that increasing copyright protection increases incentives to create new works. When Congress or the courts increase the amount of copyright protection available to authors, a rational author seeking to increase her wealth will respond by creating more works. While this model does a good job of describing the public good nature of creative works

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164. This discussion assumes that there is no distinction between creators of copyrighted works and the owners of copyrights. As such, some of the disconnect between legal changes and behavior may be the result of a disjunction between authors and copyright owners either because their interests do not align or because the reality of who actually owns the copyright obscures both the perceived and actual rewards available to creators as a result of the legal change.

165. William M. Landes & Richard A. Posner, *An Economic Analysis of Copyright Law*, 18 J. LEGAL STUD. 325, 327 (1989).

166. *Id.* at 327.

and how those works may be underproduced as a result of piracy, it does not accurately represent the decision to create a work in the first place.

An initial criticism of this analysis is that this model does not account for the fact that copyright law represents a potential cost in the creation of new works. Because no author creates in a vacuum, increasing copyright protection is a double-edged sword. While new laws may increase the potential reward for creating, they simultaneously increase the cost of creating in two ways. First, in order to create a new work, the author of a new work may be required to obtain permission from another copyright owner, thus incurring transaction costs and potentially the cost of a license or royalty payment. As a result, an author may decide to alter her work or create an entirely different work from the one she intended to avoid incurring those expenses or potential liability. Under either circumstance, the additional costs created as a result of increasing copyright protection may be sufficient to deter the creation of new works.

Recognizing this limitation, Landes and Posner more recently set forth a model taking the cost of copyright law into account.[167] According to the authors:

> The intuition behind these results is straightforward. Some copyright protection is necessary to generate incentives to incur the costs of creating easily copied works. But too much protection can raise the costs of creation to a point at which current authors cannot cover their costs even though they have complete copyright protection for their own originality."[168]

Assuming that Landes and Posner's more detailed model better reflects the costs and benefits associated with changes in copyright law, two points arise. First, while the authors consider the possibility that increasing copyright protection could ultimately "raise the costs of creation to a point at which current authors cannot cover their costs,"[169] they do not consider the possibility that the increase in costs

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167. LANDES & POSNER, *supra* note 13, at 73 ("The supply of works will equal $N = N(R, z)$ where $N_R > 0$ and $N_z < 0$. The net effect on N of an increase in copyright protection (z) depends upon the balance between two effects because the increase leads to both a movement up the supply curve of works (as R increases) and an upward shift of the supply curve as z drives up the cost of expression. Thus $dN/dz = N_R(dR/dz) + N_z$. At low levels of z, the revenue-enhancing effect of limiting copying by free riders should dominate, so that $dN/dz > 0$. When z is very low, few or no works may be created, since free riding by copiers may prevent any author from covering his cost of expression. So N will increase as z increases, at least up to some level, say $\underline{z}$. Beyond $\underline{z}$ we assume that increases in the cost of expression to marginal authors will dominate, so that the number of works will begin to fall.").

168. *Id.* at 74.

169. *Id.*

may offset marginal increases in incentives. In other words, while a little copyright is good and a lot may be bad, anything in between may be meaningless when it comes to incentives. Recall the example of term extension raised by Justice Breyer in *Eldred*, where he noted that the estimated present value of the increased length of copyright protection for even the most successful copyrighted works is seven cents.[170] When one considers that one of the least expensive licensing fees—the mechanical royalty rate for a compulsory license to cover another author's song—is 9.1 cents,[171] it is not difficult to imagine that the new costs created by the legal change will offset any new reward.

Second, to the extent that changes in copyright protection apply to both existing and new works, legal changes may not increase the number of new works because they favor a strategy of exploiting existing works rather than creating new ones. Having already created the initial work, an author does not need to consider whether to create a different work in response to the legal change. As such, the author does not incur costs associated with steering clear of potential liability. Similarly, in those instances when existing works may be rendered infringing on the rights of earlier works because of subsequent changes in the law, Congress has often accommodated those works either by creating specific exemptions for their continued exploitation or through compulsory licensing. As a result, legal changes generate lower transaction costs for authors of existing works than for authors of new ones. Lastly, it is always less costly to copy than to create something new—especially when a creator copies herself. Consequently, increasing copyright protection may not produce increases in the number of new works because the costs associated with legal changes may lead wealth-maximizing copyright owners to prefer licensing over creation. This argument should come as no surprise to those versed in economics: creators in these cases are engaged in rent-seeking behavior. However, because the economic model assumes that the question facing authors is a simple binary question of to create or not to create, this strategy does not appear.

More fundamentally, however, the existing economic model is incomplete because it is premised upon two erroneous assumptions: (1) the new work will be successful in the marketplace, and (2) authors are currently creating fewer works than they are capable of producing. To demonstrate that copyright is a useful response to the public good nature of creative works, even Landes and Posner's more detailed

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170. 537 U.S.186, 254–55 (2003) (Breyer, J., dissenting).

171. *See* U.S. COPYRIGHT OFFICE, COPYRIGHT ROYALTY RATES, SECTION 115, THE MECHANICAL LICENSE (2006), http://www.copyright.gov/carp/m200a.html.

economic model examines an author's incentives in response to competitor copying by assuming demand for the work.[172] Under these circumstances, their model actually predicts that increasing copyright protection will increase the revenues available to copyright owners and will increase the incentive to produce more copies of the same work to compete against copiers. While related, their model is not the same as a model that predicts an individual author's decision whether to create a new work in a functioning market protected by copyright law. Nor is it a model that predicts how changes in copyright law will influence that decision. Any model examining whether changes in copyright law influence individual incentives to create new works must consider the possibility that there may be no demand and no market for the work at all.

Even under a profit-maximizing model, one must discount potential revenues based upon the likelihood that the public will desire the work. After all, some works are just as undesirable at half the price, and some may not find an audience even when given away for free. In other words, a new work (N) will be created if the anticipated income (R(z)) created by copyright law (z) discounted by the probability that the public will actually desire the work (P) is greater than the cost of the work (C). Cost is a function of opportunity costs (O), materials (M), and copyright law.[173] This inequality may be formally stated as follows:

If $P(R(z)) > C(O,M,z)$, then N will be produced.

Consider how this decisionmaking process applies to new authors and established authors. Regardless of whether the odds of being published are the same as the odds of winning the lottery, or are just small because new authors do not know if the public will find their work appealing, new or unknown authors are in the most difficult decisionmaking position. Even assuming that the basic costs of creating a new work and the potential revenues are essentially the same for established authors, new authors are subject to greater uncertainty and are likely to discount the revenue side of the equation at a higher rate. For a new author, P is an unknown quantity and could range anywhere from zero to one. In response, one strategy could be to keep costs down to a minimum and consider only whether

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172. LANDES & POSNER, *supra* note 13, at 71.

173. Arguably all of this is also subject to a natural limit for talent.

one's time is better spent creating rather than engaging in some other revenue-producing labor.[174]

Even then, under a wealth maximizing theory, no new works should be created because a rational wealth-maximizer would not engage in what is essentially a gamble. In other words, for a new author, the creative process is a gamble because the losses are guaranteed while the payoff is uncertain. For example, assume that it takes 365 ten-hour days to write a book. Further assume that the writer would have earned ten dollars per hour working at another job instead of writing. Assuming no additional costs, writing the book cost the writer $36,500. At a royalty rate of $2.50 per book, the author would need to sell 14,600 books to break even. Yet there is no guarantee that the author will sell even a single copy.[175] While the author can do more to improve her probability of success—for example, researching successful works, rewriting her work, attending seminars, seeking out agents, and learning more about the publication process—these steps are guaranteed to increase her costs, while the payoff still remains uncertain. While changes in copyright law may change both costs and potential payoff, they do little to change the fact that for a new author, the probability of success, P, is unknown—and for most new authors, P is also extremely low. As such, changes in copyright law should have little impact on the number of new works produced under this model by unknown authors.

Next, consider the decisionmaking process for established authors. Unlike the new author, we can assume for purposes of this discussion that the established author's probability of success, P, is more certain and may even approach one (certain success). For instance, when an established author obtains an advance from a publisher sufficient to cover the author's costs, P is probably very high. Under these circumstances, for changes in copyright law to have an effect on an established author's productivity, we must assume that

174. Of course, this is a very limited model of human behavior and economists in general would look to utility rather than simply wealth. In other words, an author may simply prefer to spend time writing rather than working for $10/hour or prefers that activity to competing leisure activities. This will be discussed in greater detail later. However, once we move beyond the profit maximizing preferences, the persuasiveness of the economic incentive justification for copyright protection diminishes accordingly. In other words, if an artist creates because she values the act of creation regardless of or beyond the financial rewards associated with creation, then it is no longer meaningful to speak in terms of the need for law to create financial incentives to encourage creation. Instead, it is arguably more meaningful to speak in terms of law's role in giving such individuals opportunities for creation.

175. For comparison purposes, by one estimate, it is possible to have a New York Times best seller by selling 5,000 hardcover copies in a single week. Tess Gerritsen's Blog, http://tessgerritsen.com/blog/2007/07/18/how-many-copies-sold-is-a-bestseller/ (last visited Oct. 8, 2009).

the author is currently working at less than full capacity. In other words, the established author is producing fewer works than she is capable of producing. As such, increasing the potential rewards available should induce the author to be more productive.

The difficulty with this assumption is that it is inconsistent with the basic economic model behind copyright law. If copyright law has done its job against free riders and provided profit-maximizing authors with the opportunity to recoup their costs for a given work, those authors should already be producing the maximum number of works they are capable of producing without sacrificing quality. In other words, the financial incentive to create new works already exists because copyright law already creates those incentives by addressing the underproduction created by free riding. From an incentive perspective, any additional rewards created by increasing copyright protection would represent a windfall to copyright owners from consumers. Under these circumstances, the only way to increase the number of works produced would be to increase productivity.[176] Generally, increases in productivity are brought about by changes in technology and pharmacology, not law. If the economic opportunity already exists, the economic model assumes that *homo economicus* will exploit it.

Some readers might note that if people actually behaved like *homo economicus*—risk averse and seeking only to maximize wealth—there would be no creative works except those funded in advance through some system of patronage. Nonetheless, people continue to create even when they are unknown and their likelihood of success is small. One might explain this behavior by rejecting the rational actor model and positing that individuals create for reasons beyond financial remuneration—in other words, individuals do not always behave rationally. While both of these factors are probably at play in the decision to create, we need not abandon the rational actor model for the purposes of this discussion. Even if one accepts that under certain circumstances, this behavior can still be considered rational, changes in copyright protection are still unlikely to change individual behavior.

Consider the case of lotteries. Edward McCaffery argues that even playing the lottery is a rational decision because for some individuals, playing the lottery is the only legally available means of

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176. This assumes that creativity is purely a function of labor rather than talent, insight, or inspiration.

obtaining greater economic freedom.[177] Moreover, those individuals prefer playing the lottery over other uses of their money.[178] For authors and artists, while it may be irrational to starve or freeze to death because of their love of music or poetry, after meeting their basic needs, it may well be rational for them to spend their spare time creating. Not only may authorship be what one prefers to do, it may also be the best strategy for dramatically improving one's economic well-being.

So should changes in copyright law change the behavior of new authors under these circumstances? The answer is once again no, but the reason is now the same as that for established authors. In order to encourage more creativity from these individuals, we must once again assume that prior to the legal change they were creatively underproductive. Put differently, we must assume that before the legal change individuals who had the talent and inclination to spend their time creating works and who realized that succeeding as an author was really their only strategy for obtaining greater economic freedom did not have sufficient motivation to create. They were not working hard enough after waiting tables, working at the assembly line, or sitting in front of a computer monitor.

As long as copyright law responds to the public good problem of creative works, the law already makes it possible for these individuals to escape their current financial conditions, and rational individuals in their situation should already be creating as much as their circumstances allow. In other words, if I know that by spending my evenings writing a book, I could become a billionaire like J.K. Rowling, but I choose to watch television instead, why would changing copyright law change my behavior? Fully understood, even the wealth-maximizing, rational actor model of copyright does not support the idea that increasing copyright protection beyond the protection necessary to address the public good problem will increase the number of copyrighted works produced. While increasing copyright law will provide greater financial rewards to authors, it does little to change their incentives to create new works.

VI. CONCLUSION: CAN LAW ENCOURAGE GREATER CREATIVITY?

Until now, the theory that increasing copyright protection increases incentives to produce more new works—and therefore leads

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177. Edward J. McCaffrey, *Why People Play Lotteries and Why It Matters*, 1994 WIS. L. REV. 71, 102.

178. *See id.*

to the production of more works—has gone largely untested. In this Article, we tested this theory using statistical analysis and demonstrated that one cannot predict when a legal change will be associated with a change in copyright registrations. Furthermore, we argue that the theoretical model upon which this hypothesized relationship has been based is incomplete.

Our study suggests that when lawmakers consider whether to expand copyright law, there is little empirical or theoretical support for the position that increasing copyright protection will increase the number of new works created. Based upon the historic data, the most that can be expected is a 38 percent chance that the new law will be associated with an increase in the number of new registrations for some unknown category of work. In contrast, lawmakers are more likely to find a relationship between an increase in the number of new works and those laws that reduce or otherwise limit copyright protection, and even then the relationship is far from guaranteed. Expecting a legal change to increase the number of new copyrighted works is akin to shooting a gun with both live ammunition and blanks at targets moving in the dark. You will occasionally hit a target, but you will not know when this will happen or which target you will hit. Population size, not law, is uniformly and consistently the best predictor of the number of new works produced.

Given these findings, one might be tempted to jump to the conclusion that copyright law does not matter. Nothing, however, could be further from the truth. While changes in copyright law may have little to do with the number of new copyrighted works created, this does not mean that copyright law has no impact. First, copyright law clearly plays a role in the creation and distribution of wealth. By one estimate, in 2005 the value added to U.S. GDP by the "core" copyright industries was $760.49 billion; that number increases to $1.38 trillion with the inclusion of all copyright industries.[179] These industries employed 5.38 million and 11.32 million individuals, respectively.[180] Copyright law clearly helps create and protect this wealth and these jobs. Likewise, the recent $100 million judgment in favor of Mattel's Barbie dolls against the manufacturer Bratz illustrates that the stakes—even in individual copyright cases—can be quite high.[181] So while increases in copyright protection may not

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179. STEPHEN E. SIWEK, COPYRIGHT INDUSTRIES IN THE U.S. ECONOMY: THE 2006 REPORT 2 (2006), *available at* http://www.iipa.com/pdf/2006_siwek_full.pdf.

180. *Id.* at 11.

181. Associated Press, *Jury Awards Mattel $100M in Barbie-Bratz Lawsuit* (Aug. 26, 2008), *available at* http://wbztv.com/business/barbie.bratz.lawsuit.2.803672.html.

provide greater incentives, such protection certainly is an important basis for distributing wealth in society.[182]

Second, because our data began with changes to copyright law following 1870, our study only examined whether those changes influenced the number of new works subsequently produced. Our study did not address whether those works would have been created absent copyright or under a less protective regime. Moreover, while creativity may occur absent copyright law, our model did not question the position that a basic level of copyright protection is necessary to combat the underproduction of creative works that is likely to result from piracy.

Third, because this study focused upon copyright registrations, we do not know the impact of copyright's expansion on the large body of creative works outside the copyright regime. To the extent that creators of these works fear liability and criminal prosecution, copyright's expansion—especially its more recent, well-publicized expansion[183]—may be deterring an unknown number of valuable creative works. Alternatively, copyright may have absolutely no effect on these works at all; we simply do not know.

If increasing copyright protection is unlikely to increase the number of new works created, what can society do to encourage creativity? While a full discussion of these strategies is beyond the scope of this Article, we can outline four suggestions:

(1) *Improve the likelihood of success.* If we want people to create more works, we could take steps to make it more worth their time and effort. Rather than focusing on expanding the jackpot, we could take steps to improve the odds that authors would recoup their investment in creativity, even if the rewards are smaller. We could increase direct funding for the arts or increase the number of prizes available for new works. We could also facilitate the distribution and accessibility of creative works, making it easier for authors to reach small audiences. To the extent that copyright law and its theories of secondary liability stand in the way, they should be amended. To the extent that incumbent businesses place roadblocks in the way, they should be removed.

(2) *Reduce the cost of creation.* Related to improving the likelihood of success is the strategy of reducing the cost of creation.

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182. There may very well be good and sound public policy reasons for providing authors with greater rewards. Our study, however, casts serious doubt on the idea that the incentives argument can reasonably be considered one of them.

183. *See, e.g.,* Greg Sandoval, *YouTube Users Caught in Warner Music Spat,* CNET NEWS (Jan. 27 2009), http://news.cnet.com/8301-1023_3-10150588-93.html (reporting some of the copyright problems created by YouTube videos).

The easier it is to create, the more likely people are to create. Teach people to create, provide them with the skills and expertise, provide them with the physical tools, and provide them with the opportunity to create. Take advantage of technologies that reduce the cost of creation, communication, and interaction, reduce copyright protection when it is a barrier to creativity, and reduce transactions costs, including registration fees.

(3) *Recognize the saliency and optimism bias.* If our preceding strategies aspire to improve the actual likelihood of "success," this strategy seeks to influence the perceived likelihood of "success." Researchers in the cognitive sciences have identified two important aspects of human decisionmaking that are relevant here. First, individuals tend to be overly optimistic about their chances of success. Second, individuals tend to estimate the probability of something occurring by how easily they may recall something similar.[184] While we should not exploit these biases as a means of manipulation, we should recognize the problems created by bounded rationality and take steps to ensure that people have the opportunity to satisfy their genuine preferences. These goals can be achieved in part through suggestion four.

(4) *Genuinely value creativity and the arts.* If the intent behind copyright law's expansion is to send a message that society values creativity, that message is far from clear. Copyright expansions and the changes associated with them are more likely to signal that some forms of creativity (or even some groups in society) are favored and others disfavored. Because copyright law works in the negative— effectively saying "do not use this work, do not copy this work, do not imitate this work"—we are not sending a message that society values the creation of new works. We are only sending the message that we should stay away from those works already created. By taking the steps outlined above in suggestions one and two, we would send a clear message that we value creativity. Moreover, recognizing the issues of bounded rationality outlined in suggestion three, that message should be reinforced publicly, prominently, and regularly by honoring and recognizing the creators among us. This recognition would make it easier for people to recall the success stories of authors, and it would encourage them to become authors themselves.

This outline is not easy, but neither is creativity. For hundreds of years, the logic of copyright's expansion has been so compelling, and the means so seemingly inexpensive and simple, that lawmakers have

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184. *See* DANIEL KAHNEMAN, PAUL SLOVIC, & AMOS TVERSKY, JUDGMENT UNDER UNCERTAINTY: HEURISTICS AND BIASES 11 (1982).

not seriously contemplated other methods for encouraging creativity. Unfortunately, our study suggests that this theory behind copyright's expansion is flawed. The evidence strongly suggests that the means do not achieve the desired ends. While increasing copyright protection provides authors with greater financial rewards, it does little to change their incentives to create new works. If we truly want to encourage the creation of new works, we must rethink and re-envision the relationship between law and human creativity and ensure that copyright law provides bounty, not booty.

APPENDIX 1: FORMAL STATISTICAL ANALYSIS

The following demonstrates our statistical analyses supporting the arguments in paper. We want to emphasize that the seven "individual" relationships *between* the number of the copyright registrations in each of the seven categories (monographs, serials, performing arts, motion pictures, photography, sound recording, and visual arts) and the five possible explanatory variables[185] (year, population, GDP, copyright registration fee, and law/technology changes) may be different among themselves and may not represent the "overall" relationship between the *total* number of copyright registrations and the explanatory variables. Therefore, we conducted careful statistical analyses to find eight best models that fit the data and represent the seven individual and one overall relationship. The first step in our analyses was an exploratory data analysis ("EDA"), which is important in setting a basis for next-step formal model fitting and data analyses.

Exploratory Data Analysis

The explanatory variables include Year, GDP (the real gross domestic product per capita), Pop (population in thousands), Fee (the copyright registration fee adjusted for inflation), and Law/Technology changes (the year when a new law or technology change became effective).[186] The Year and Pop variables are highly correlated, having almost a perfect linear relationship.[187] Indeed, the relationships between the number of copyright registrations and year, and the number of copyright registrations and population, are very similar as shown in Chart 2 and Chart 11. Thus, in our final models, we expect that either the Year or Pop variables (but not both) will be chosen as a significant explanatory variable. This is consistent with Landers & Posner's observation that the year variable largely picks up the increase in population.

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185. The synonyms for independent variables in a regression model include explanatory variables and covariates. Also, here the law and technology changes represent a group of eighty-six dummy variables.

186. Among these five variables, the law and technology changes happened in eighty-six years during 1870 to 2006, and hence the fifth group "law/technology changes" represent eighty-six dummy variables.

187. *See* Chart 10.

CHART 10. POPULATION VS. YEAR (1870-2006)
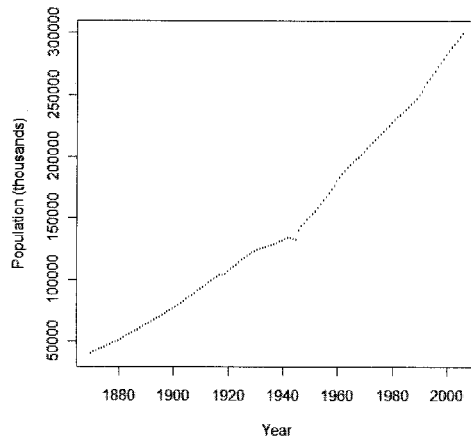
CHART 11. TOTAL NUMBER OF COPYRIGHT
REGISTRATIONS (1870-2006) VS. POPULATION (YEAR)
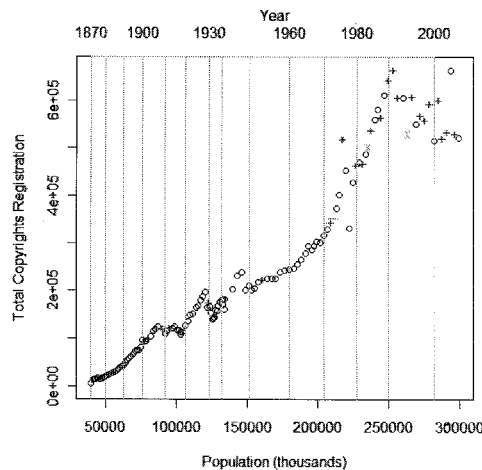
In Charts 11 and 12, the total number of copyright registrations and the number of registrations for each of the seven subcategories are plotted against population and year. A "+" marks the years in which the law supposedly increased protection, while a "-" represents the years in which laws limited protection. An "x" represents laws that both increased and limited protection. Our formal statistical analyses below will examine if the data support these normative perceptions about copyright laws.

CHART 12. COPYRIGHT REGISTRATION PER SUBCATEGORIES VS.
POPULATION (YEAR)
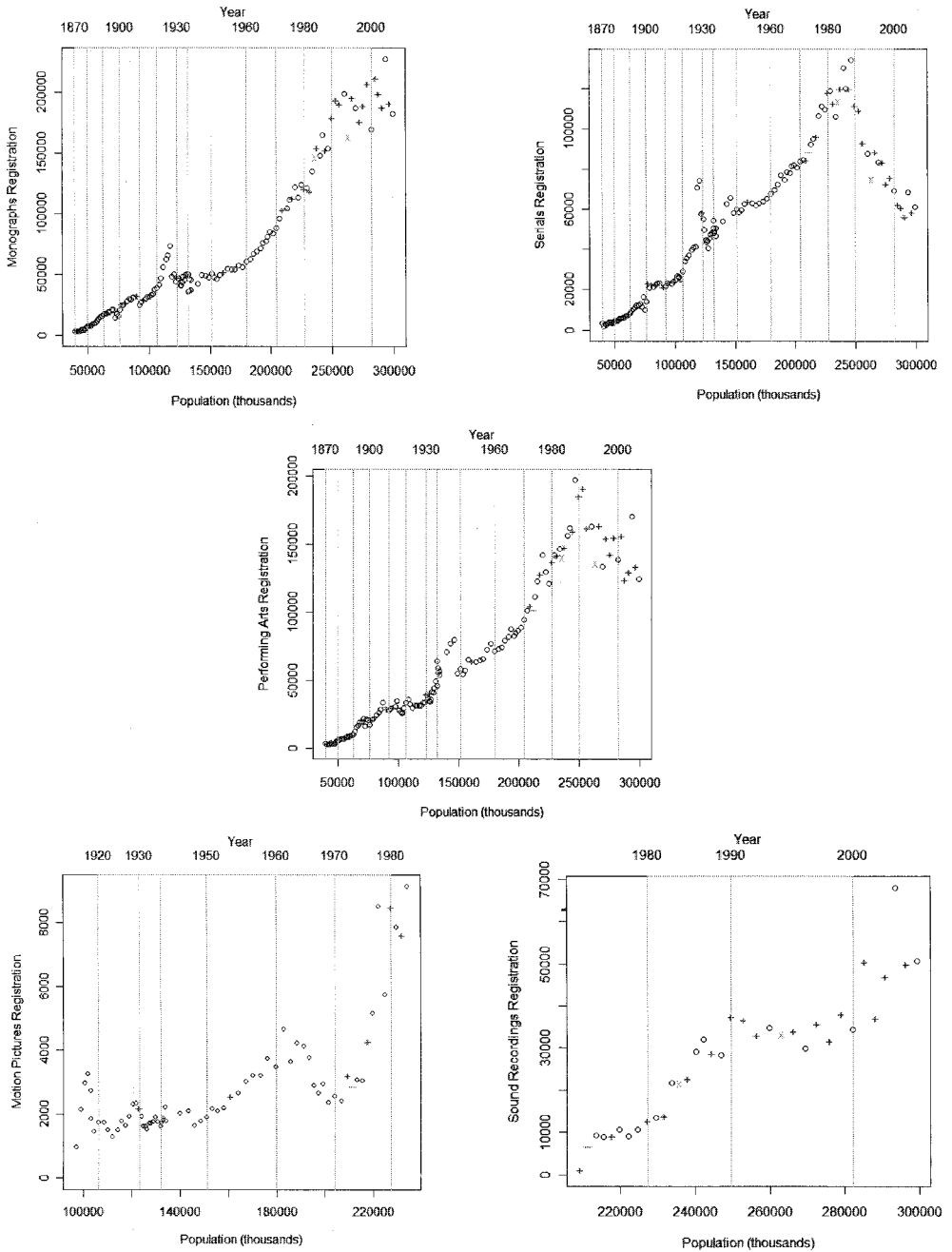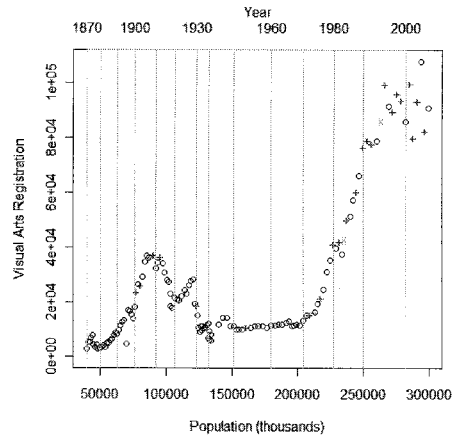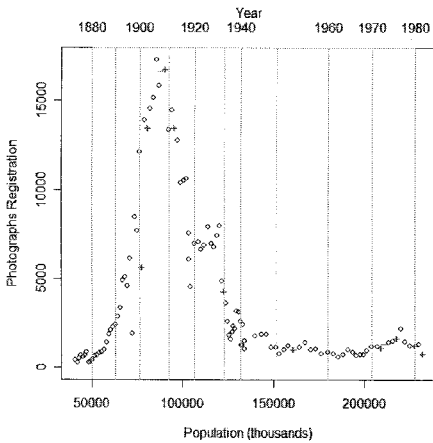
From Chart 11, the total number of copyright registrations apparently had an overall upward trend for more than a century despite a bump around 1929. The trend has become less clear and more volatile since 1990, which is probably due to the large number of laws introduced after 1989. Moreover, some supposedly positive legal changes did not seem to have the expected positive impacts on the total number of copyright registrations.

In Chart 12, four categories—monograph, serials, performing arts, and visual arts registrations—spanned the entire time range (1870-2006), while two categories—motion pictures and photographs— had their data ends in 1980s, and one category—sound recording— had its data starting in 1980s. The first three categories—monograph, serials, and performing arts registrations—were the dominant categories driving the total number of registrations. Until 1989, these three categories appeared to have a similar overall trend to that of total copyright registrations. The only difference was that monograph and serials registrations had a bump around 1929, while the performing arts registrations peaked a few years later. Monographs stayed relatively flat during 1930s and 1940s, and they started to increase during the 1950s. In contrast, performing arts were flat from 1905 to 1930. The stagnation of monograph registrations was probably due to the Great Depression that started in 1929 and lasted into the 1930s and early 1940s. The Great Depression had devastating effects to the economy, and perhaps also stifled creativity or copyright registrations because survival was the priority.

After 1989, monograph registrations seemed to continue their upward trend (though in a slower rate than before 1989), while serials and performing arts registrations shifted to a downward trend. The monograph's upward trend likely offset the downward trends in

serials and performing arts registrations, leading to the unclear trend shown in the total overall registrations after 1989 in Chart 11. Also, the variances of the numbers of copyright registrations became volatile for most categories after the critical year of 1989. To confirm and test this visual observation statistically, we conducted a change point analysis. While registration rules changed following 1989, the changes after this year might also be evidence that new technology hurt the number of subscriptions for serials, performing arts, and even for monographs (since the number of monograph registrations grew more slowly after 1989).

Among the seven categories, sound recording registrations, created in 1972, had the shortest span of history, extending until 2006. Motion picture copyright registration had the second shortest life span from 1913 to 1983. Motion picture copyright registrations peaked in 1961, and then declined until 1970 before increasing dramatically again. Photographic registrations (also ending in 1983) peaked around 1912 before motion pictures copyright registrations were given their own category. It might have taken some time for the old classification of including motion pictures in photographic registrations to end either because of the changes in technology (i.e., moving to film) or practice. Since some of the motion picture copyright registrations dwelled under photographic copyright registrations for an unknown period of time, modeling the photographic registrations data will be meaningless. Therefore, we did not perform a formal statistical analysis on the photograph registration data. An interpretation of a model fitted to motion pictures registrations should also take into the consideration that a small portion of its early data (around 1915) might have remained in the photographic group.

Visual arts registrations peaked around 1910 (note its scale in the Y-axis in comparison to that of photographic registrations), then flattened during the 1950s, and peaked again around 2000. However, like the other registrations, the visual arts trend also became volatile after 1989.

Based on the findings from the simple exploratory data analysis above, we conducted the following analyses for six copyright categories—monographs, serials, performing arts, motion pictures, sound recordings, and visual arts registrations—using the following methodology:

Step 1. We used change point analysis[188] to detect if and when an abrupt change had taken place under a logarithm linear or quadratic model. All the results on monographs, serials, performing arts, and visual arts copyright registrations data indicated year 1989 was the change point location.

Step 2. Since the numbers of copyright registrations were measured longitudinally through the period of 1870-2006, we applied a time series model to the residuals in each of our regression analyses.

Step 3. We fitted nonparametric curves to the data in an attempt to guide us in choosing suitable parametric models in Step 4. Nonparametric simultaneous confidence bands[189] ("SCB") for nonparametric curves were superimposed to the fitted nonparametric regression curves. Specifically, in our nonparametric model we assumed an additive error structure for longitudinal data x:

$$Y_i = f(x_i) + \varepsilon_i,$$

and constructed SCBs through the software package Locfit in Splus. Chart 13 displays the results. Incorporating the change point analysis with SCB allowed us to obtain better, more objective inferences.

It is clear from Chart 13 that for most categories a simple parametric model—such as a linear regression, quadratic, or log-transformation—cannot adequately capture the data pattern over the entire period from 1870 to 2006. Specially, these parametric models failed to capture the bump of the latter 1920s, the plateau during 1930s and 1940s, and the heteroscedasticity of variance before and after 1989. Instead, a segmented multiple log-linear regression analysis for each category of copyright registrations, as described in Step 4 below, provided a much better fit to the data.

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188. *See* S. J. Ganocy, Estimation Problems from Data with Change Points (Aug. 2003) (unpublished Ph.D. dissertation, Case Western Reserve University), *available at* http://stat.cwru.edu/~ sjganocy/sjg.pdf.

189. Jiayang Sun, Jonathan Raz & Julian J. Faraway, *Confidence Bands for Growth and Response Curves,* 9 STATISTICA SINICA 679, 679–98 (1999).

CHART 13. NONPARAMETRIC SIMULTANEOUS CONFIDENCE BANDS FOR
COPYRIGHT REGISTRATIONS OF MONOGRAPHS, SERIALS, PERFORMING
ARTS, MOTION PICTURES, SOUND RECORDING, AND VISUAL ARTS
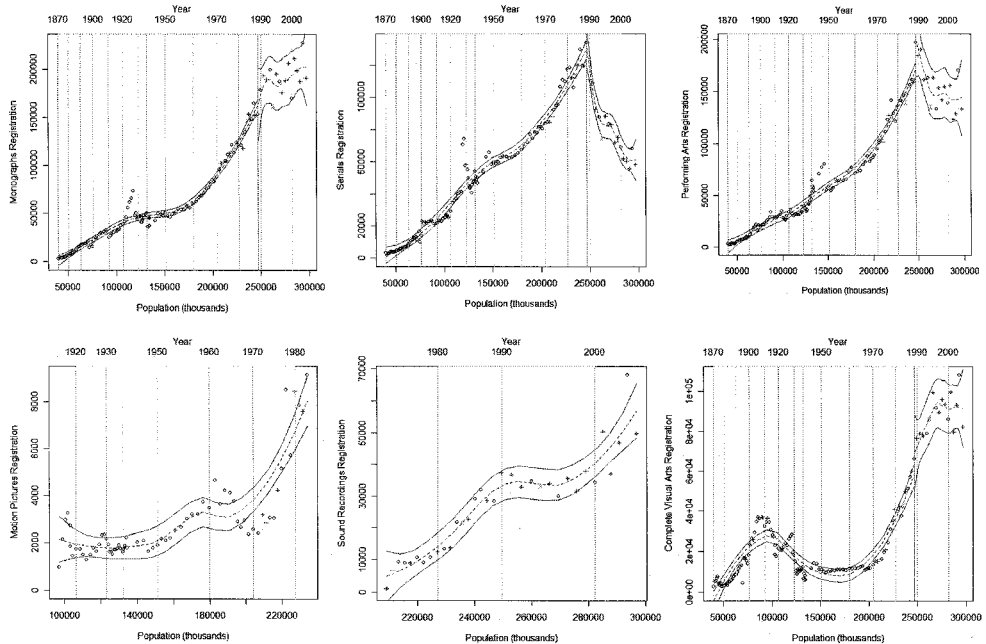
Step 4. We fitted the best-segmented regression models in the
form of equation (1) below to five categories: monographs, serials,
performing arts, motion pictures, and sound recordings. We only
applied nonparametric analysis to the visual arts data because a
piecewise log-linear or log-quadratic model cannot fit the data
reasonably well.

Segmented log-linear model: For years from 1870 to 1989, the
model has the form:

$$Log_{10}(Y) = \beta_0 + \beta_1 Log_{10}(\text{GDP}) + \beta_2 Log_{10}(\text{Pop}) +$$

$$\beta_3 Log_{10}(\text{Fee}) + \sum_i c_i L_i + \sum_j d_j T_j + \varepsilon(1), \qquad (1)$$

where Y is the number of copyright registrations of a given category;
GDP, Pop, and Fee are as explained in the first paragraph of this
Appendix; ε is the random error; and L_i and T_j are the dummy
variables representing a legal (or technology) change starting from its
effective date (a year after its introduction) and continuing until to the
end of the study. For data in years 1989 to 2006, our models are

similar to equation (1), although the estimated coefficients—β, c_i and d_j—and their statistical significances are different from those in early period 1870-1989. See the results in Tables 1 to 9.

During the regression analysis in Step 4, legal change and technology change effects were set one year later. We assumed that it took about one year for these to take effect on the number of registrations. We also performed analyses in which legal and technology changes were lagged by two and three years respectively, but we concluded that the one-year lag was the best-fit model.

For each of five categories, we fit and examined a time series regression model by iteratively estimating the regression coefficients β, c_i and d_j, and the covariance structure of ε, as follows:

Step 1. Computed an initial regression fit to equation (1) without assuming any correlation structure on ε, using the OLS. This provides initial estimates of β, c_i and d_j, and the residuals ε.

Step 2. Ran the autoregressive and moving average ("ARMA") procedure in SAS software on the residuals to identify the best ARMA model, via the Bayesian information criterion ("BIC"), for the covariance of ε. This step also provided estimated AR and MA coefficients.

Step 3. Computed a generalized regression fit that incorporates the estimated ARMA covariance structure[190] using the generalized least square ("GLS") procedure.

Step 4. Performed a stepwise model selection procedure to choose the significant explanatory variables under the time series regression model. This step also provided updated residuals and estimated regression coefficients.

Step 5. Returned to Step 2 and continued until the convergence, or the differences between the successive regression coefficients and ARMA coefficients were negligible. The final models for each of the categories are listed in the following sections.

Study in each category

(1) Monographs copyright registration analysis

For data between 1870 and 1989, from SAS output, an ARMA(0, 1) model with a moving average parameter MA = -0.1521 had the lowest BIC, and hence, was chosen. The resulting estimated coefficients for those in equation (1) are given in Table 1 below.

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190. Such a generalized model is called a time series regression model.

TABLE 1. REGRESSION ANALYSIS OF MONOGRAPH COPYRIGHT
REGISTRATIONS (1870-1989)

Factors	Coefficients	Estimated coefficients	Corresponding t value	$Pr(>|t|)$
(Intercept)	β_0	-5.8851	-9.7066	0.0000
Log_{10}(GDP)	β_1	0.1591	2.6502	0.0094
Log_{10}(Pop)	β_2	1.9563	12.8244	0.0000
Law1870	c_{1870}	-1.0946	-9.1502	0.0000
Law1886	c_{1886}	0.0981	7.8905	0.0000
Law1909	c_{1909}	-0.128	-9.2233	0.0000
Law1912	c_{1912}	0.0213	1.6179	0.1090
Law1971	c_{1971}	0.0254	1.6386	0.1046
Law1980	c_{1980}	-0.0332	-2.1431	0.0346
Law1982	c_{1982}	0.0553	3.4506	0.0008
Tech1877	d_{1877}	0.1492	12.1993	0.0000
Tech1882	d_{1882}	0.0509	3.8372	0.0002
Tech1896	d_{1896}	-0.1445	-11.8505	0.0000
Tech1900	d_{1900}	0.1122	9.2377	0.0000
Tech1921	d_{1921}	0.1116	8.4844	0.0000
Tech1924	d_{1924}	0.0671	3.6223	0.0005
Tech1926	d_{1926}	-0.1815	-8.7622	0.0000
Tech1928	d_{1928}	-0.0453	-2.5386	0.0127
Tech1932	d_{1932}	-0.05	-4.3561	0.0000
Tech1941	d_{1941}	-0.1287	-6.1785	0.0000
Tech1943	d_{1943}	-0.042	-2.2756	0.0251
Tech1946	d_{1946}	0.0439	2.693	0.0084
Tech1950	d_{1950}	-0.0923	-7.2653	0.0000
Tech1969	d_{1969}	0.025	1.579	0.1176

Multiple R^2 = 0.9987

The R^2 in Table 1 is very close to 1, which is not surprising, because the R^2 of the regression of the number of registrations on the first three explanatory variables—GDP, Pop, and Fee (hereinafter "Main Factors")—alone was 0.96. With the legal and technology changes as additional explanatory variables, the remaining variation in the number of registrations (that was not captured by the Main Factors) was mostly accounted for. Of course, one might worry about over fitting with too many law and technology dummy variables in the model. In our analyses, pre-filtering and a stepwise variable selection

procedure were performed to eliminate obvious nuisance variables and to determine the statistically significant law and technology variables shown in Table 1 (which constitute a subset of all the law and technology variables). The significance of these variables is fairly consistent with what is shown in the partial regression plot in Chart 14, explained in detail below.

Interpretation. Based on equation (1), the estimated relationship (in the original scale) between the number of registrations and the significant explanatory variables shown in Table 1 is

$$\hat{Y} = 10^{\beta_0} (GDP)^{\beta_1} (Pop)^{\beta_2} (Fee)^{\beta_3} (10)^{\sum_i c_i L_i + \sum_j d_j T_j} \qquad (2)$$

The law and technology variables not shown in Table 1 have zero coefficients. An interpretation of the significant coefficients—β, c_i, and d_j—must take into consideration a multiple regression in which all significant explanatory variables were working together simultaneously. So, for example, $\beta_2 = 1.9563$ contributed to Y (the number of monograph copyright registrations) in terms of a multiplication factor of $(Pop)^{1.9563}$. In statistics, the coefficients like β_2 are called partial regression coefficients. Partial regression coefficients are the slope of a simple regression of E_2 on E_1. For $\beta_2 = 1.9563$, E_2 is the residual of $Log_{10}(Y)$ regressed on all other factors such as GDP, Fee, L_i, and T_j; thus, E_2 *is the remaining variation in $Log_{10}(Y)$* after removing the variation captured by these factors. E_1 is the residual of the population factor $Log_{10}(Pop)$ regressed on GDP, Fee, L_i's, and T_j's; in other words, E_1 is the remaining variation in $Log_{10}(Pop)$ after removing the effect of these specified factors. Hence, this partial regression coefficient will generally be different from the coefficient in a simple regression of the original number of registrations, $Log_{10}(Y)$, regressed on the population, $Log_{10}(Pop)$. A simple regression often misses the contribution of other factors, leading to omitted variable bias.

Partial regression coefficients sometimes have same signs with those of their corresponding individual coefficients. When a partial regression coefficient has a different sign from that of its corresponding individual coefficient, it simply means that this explanatory variable is included in the model to adjust for its effect that has already been captured in some degree in other explanatory variables that are correlated with this particular explanatory variable.

Chart 14 is our modified version of a typical partial regression plot, in the base-10 logarithm scale, on the contributions or effects of legal and technology changes to the monograph copyright

registrations (after considering the effects of main explanatory variables, such as GDP, the population, and fee) before 1989. Based on Table 1, the fee is not a significant explanatory variable, so it will not appear in the remaining discussion in this paragraph. A typical partial residual plot is a plot of E_1 against E_2, in which, in our case, E_2 is the residual of the number of monograph registrations regressed on log(GDP) and Log(Pop), and E_1 would be the residuals of legal and technology change variables regressed on Log(GDP) and Log(Pop). Since law and technology both changed over the time period, and their enactment should be independent of GDP and Pop, in our modified version, we used the same E_2, but replaced E_1 by the Year on the X-axis and marked the Year points by triangles if the significant legal and technology changes were found in our analysis.

      This plot can be used to visually examine if the coefficients in Table 1 are reasonable. For example, the Law1886 variable has a coefficient 0.0981 in Table 1. Thus, according to equation (1), the laws of 1886 contributed a multiplication factor of $10^{0.0981} = 1.2534$ to the number of monograph copyright registrations starting from the year 1887. This positive contribution is indicated by an upward triangle (the third from the left) in Chart 14. This point is consistent with the pattern of neighboring points, which all increase in the next year. All the directions except two boundary ones (the first and the last) of the triangles are consistent with the impacts expected from the corresponding legal and technology changes. Hence the estimated directions and coefficients in Table 1 are consistent with the data.

CHART 14. PARTIAL REGRESSION PLOT OF NUMBER OF
REGISTRATION OF MONOGRAPHS

Partial Regression Plot of Log-Monograph
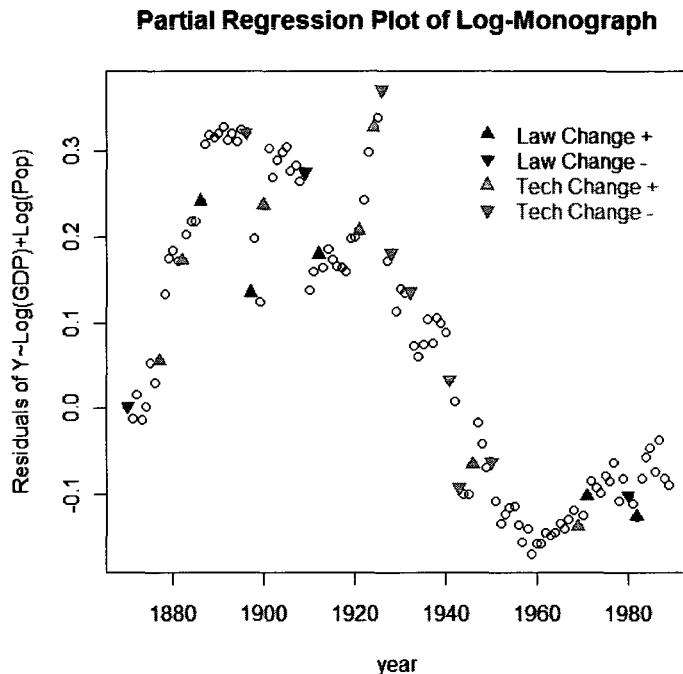
Caption of Chart 14: This modified partial regression plot of log-transformed monograph is a scatter-plot of residuals of $Log_{10}(Y) = Log_{10}(GDP) + Log_{10}(Pop)$ graphed against the Year. The significant years with legal changes or technology changes are marked by triangles filled with colors. Legal changes are marked in blue, while technology changes are marked in red. Furthermore, the upward-pointing triangles indicate a legal or technology change that had a positive effect, and the downward-pointing triangles indicate a legal or technology change that had a negative effect. We can see the pure effects of these legal and technology changes on the number of registrations only after removing the effects of the Main Factors. A minor negative legal change in the year 1870 resulted in a slight decline on year 1871. This legal change was followed by two obvious positive technology changes in 1877 and 1882—which resulted in increases in years 1878 and 1883—and a positive legal change in 1886

For the data between 1989 and 2006, we found no correlation in the random error; thus, an OLS fit with a standard stepwise selection procedure was sufficient for this second part of the monograph registration data. Although the R^2 is still remarkably high,

the R^2 is much lower for this period than for the 1870 to 1989 period due to the short span of this time period and the interference of many legal and technology changes since 1989. Indeed, as Tables 6 and 7 demonstrate, the variance is huge.

TABLE 2. REGRESSION ANALYSIS OF MONOGRAPH COPYRIGHT REGISTRATIONS (1989-2006)

Factors	Coefficients	Estimated Coefficients	Corresponding t value	Pr(>|t|)
(Intercept)	β_0	-101.357	-3.7538	0.0045
Log_{10}(GDP)	β_1	-12.1719	-4.3821	0.0018
Log_{10}(Pop)	β_2	28.4373	4.0955	0.0027
Law1990	c_{1990}	-0.1344	-2.2787	0.0487
Law1995	c_{1995}	0.0879	2.5019	0.0338
Law1997	c_{1997}	0.1319	3.3258	0.0089
Law1998	c_{1998}	0.1052	2.9393	0.0165
Law2001	c_{2001}	-0.0813	-2.3847	0.0409
Law2003	c_{2003}	0.1273	3.701	0.0049

Multiple $R^2 = 0.7987$

(2) Serials copyright registration analysis

An analysis of the data of serials copyright registrations gives similar results to an analysis of monograph copyright registrations. An ARMA(0, 1) model with a moving average parameter MA = -0.1885 had the lowest BIC. The resulting estimated coefficients for those in equation (1) are given in Table 3 below.

TABLE 3. REGRESSION ANALYSIS OF SERIALS COPYRIGHT
REGISTRATIONS (1870-1989)

Factors	Coefficients	Estimated Coefficients	Corresponding t value	Pr(>|t|)
(Intercept)	β_0	-7.3388	-8.3902	0.0000
Log_{10}(GDP)	β_1	-0.2292	-2.97	0.0038
Log_{10}(Pop)	β_2	2.4742	11.1913	0.0000
Log_{10}(fee)	β_3	-0.1373	-2.3152	0.0227
Law1870	c_{1870}	-1.6885	-8.4541	0.0000
Law1879	c_{1879}	0.0507	2.6611	0.0091
Law1886	c_{1886}	0.0319	1.6927	0.0938
Law1903	c_{1903}	-0.0547	-2.6729	0.0088
Law1930	c_{1930}	-0.0852	-2.8749	0.0050
Law1976	c_{1976}	0.0401	2.6781	0.0087
Law1982	c_{1982}	-0.0479	-2.1712	0.0324
Law1984	c_{1984}	0.0379	1.6624	0.0997
Tech1882	d_{1882}	0.0358	1.7245	0.0878
Tech1890	d_{1890}	0.0789	4.5456	0.0000
Tech1900	d_{1900}	0.1715	9.409	0.0000
Tech1907	d_{1907}	-0.0541	-1.8686	0.0647
Tech1920	d_{1920}	0.0769	5.3795	0.0000
Tech1926	d_{1926}	0.2348	10.5516	0.0000
Tech1928	d_{1928}	-0.1151	-4.0449	0.0001
Tech1932	d_{1932}	-0.0877	-3.9396	0.0002
Tech1938	d_{1938}	0.0529	2.6693	0.0089
Tech1943	d_{1943}	0.0312	1.878	0.0634
Tech1950	d_{1950}	-0.0574	-3.6451	0.0004
Tech1956	d_{1956}	-0.0634	-4.0311	0.0001

Multiple R^2 = 0.9982

During the period from 1989 to 2006, we once again detected no autocorrelation from the data of serials copyright registrations. The resulting R^2 is high, which is consistent with the small variances seen in Charts 12 and 13 for serials copyright registrations.

TABLE 4. REGRESSION ANALYSIS OF SERIALS COPYRIGHT
REGISTRATIONS (1989-2006)

Factors	Coefficients	Estimated Coefficients	Corresponding t value	Pr(>|t|)
(Intercept)	β_0	45.2574	13.3532	0.0000
Log_{10}(Pop)	β_2	-7.4466	-11.8781	0.0000
Law1994	c_{1994}	0.1128	5.4062	0.0001
Law1998	c_{1998}	0.0604	3.2133	0.0068
Law2003	c_{2003}	0.1138	6.4691	0.0000

Multiple R^2 = 0.9749

(3) Performing arts copyright registration analysis

Unlike monographs and serials, the performing arts copyright registration data between 1870 and 1989 follows an ARMA(0, 3) model. We selected this model with moving average parameter MA = (0.0960, -0.6506, -0.3387). The results are listed in Table 5 below.

TABLE 5. REGRESSION ANALYSIS OF PERFORMING ARTS COPYRIGHT
REGISTRATIONS (1870-1989)

Factors	Coefficients	Estimated Coefficients	Corresponding t value	Pr(>|t|)
(Intercept)	β_0	-0.0722	-2.0185	0.0464
Log_{10}(Pop)	β_2	0.7562	178.5619	0.0000
Law1879	c_{1879}	0.1223	4.2264	0.0001
Law1884	c_{1884}	0.0836	5.1495	0.0000
Law1897	c_{1897}	0.0611	1.8252	0.0712
Law1902	c_{1902}	0.083	4.1804	0.0001
Law1912	c_{1912}	-0.0616	-5.0205	0.0000
Law1952	c_{1952}	0.092	3.8688	0.0002
Law1973	c_{1973}	0.0622	2.5959	0.0110
Law1976	c_{1976}	0.0419	2.1937	0.0307
Law1984	c_{1984}	0.0396	2.3773	0.0195
Law1988	c_{1988}	0.0948	2.6828	0.0086
Tech1877	d_{1877}	0.1223	3.9016	0.0002
Tech1890	d_{1890}	0.1497	5.2556	0.0000
Tech1891	d_{1891}	0.1266	4.149	0.0001
Tech1895	d_{1895}	0.0863	2.5133	0.0137
Tech1896	d_{1896}	-0.1395	-4.3155	0.0000
Tech1906	d_{1906}	0.0467	2.6138	0.0104
Tech1920	d_{1920}	0.0409	1.492	0.1391
Tech1921	d_{1921}	-0.0419	-1.4779	0.1428
Tech1927	d_{1927}	0.0291	2.4101	0.0179
Tech1935	d_{1935}	0.0462	2.4433	0.0164
Tech1938	d_{1938}	0.0973	4.41	0.0000
Tech1943	d_{1943}	0.0834	5.5285	0.0000
Tech1950	d_{1950}	-0.144	-5.5938	0.0000
Tech1962	d_{1962}	0.05	4.9525	0.0000
Tech1969	d_{1969}	0.0525	3.1416	0.0023

Multiple R^2 = 0.9999

It is not surprising that no autocorrelation was detected for the performing arts registrations during the period of 1989-2006. None of the Main Factors were statistically significant. The resulting low R^2

value could be due to the large variance caused by frequently introduced new laws and technologies.

TABLE 6. REGRESSION ANALYSIS OF PERFORMING ARTS COPYRIGHT REGISTRATIONS (1989-2006)

Factors	Coefficients	Estimated Coefficients	Corresponding t value	Pr(>|t|)
(Intercept)	β_0	5.2815	208.3709	0.0000
Law1991	c_{1991}	-0.1199	-4.3172	0.0005

Multiple R^2 = 0.5381

(4) Motion picture copyright registration analysis

For motion picture copyright registration data, an ARMA(3, 1) model with autoregressive parameters AR = (0.7963, -0.0775, -0.5714) and a moving average parameter MA = -0.81 was chosen because it had the lowest BIC. The results are listed in Table 7.

TABLE 7. REGRESSION ANALYSIS OF MOTION PICTURE COPYRIGHT REGISTRATIONS

Factors	Coefficients	Estimated Coefficients	Corresponding t value	Pr(>|t|)
Log_{10}(Pop)	β_2	1.64379	9.056	0.0000
Log_{10}(fee)	β_3	-3.7018	-5.435	0.0000
Law1930	c_{1930}	-0.15989	-5.372	0.0000
Law1971	c_{1971}	0.16688	4.185	0.0001
Law1976	c_{1976}	0.10593	2.062	0.0435
Tech1921	d_{1921}	-0.25707	-6.992	0.0000
Tech1924	d_{1924}	0.12243	2.164	0.0344
Tech1927	d_{1927}	0.13903	2.488	0.0156
Tech1947	d_{1947}	0.62163	5.232	0.0000
Tech1953	d_{1953}	0.15547	9.485	0.0000
Tech1968	d_{1968}	-0.21754	-7.6	0.0000

Multiple R^2 = 0.9999

(5) Sound recording copyright registration analysis

No autocorrelation is detected for the sound recording copyright registrations before and after change point 1989. Again, this result may be due to the frequent legal and technology changes during such a short time period.

TABLE 8. REGRESSION ANALYSIS OF SOUND RECORDING COPYRIGHT
REGISTRATIONS (1972-1989)

Factors	Coefficients	Estimated Coefficients	Corresponding t value	Pr(>|t|)
(Intercept)	β_0	-49.2386	-5.951	0.0001
Log_{10}(Pop)	β_2	9.41911	6.722	0.0000
Log_{10}(Fee)	β_3	1.38905	2.215	0.04682
Law1982	c_{1982}	0.12414	3.24	0.00709
Law1988	c_{1988}	-0.08687	-2	0.06864
Tech1972	d_{1972}	0.76992	17.824	0.0000

Multiple $R^2 = 0.9922$

As with performing art copyright registrations, Table 9 demonstrates that yet again none of the Main Factors are statistically significant. Due to the large variance, the resulting R^2 has a huge decrease after the 1989 change point.

TABLE 9. REGRESSION ANALYSIS OF SOUND RECORDING COPYRIGHT
REGISTRATIONS (1989-2006)

	Coefficients	Estimated Coefficients	Corresponding t value	Pr(>|t|)
(Intercept)	β_0	4.52365	260.47	< 2e-16
Law1998	c_{1998}	0.08863	2.946	0.01001
Law2003	c_{2003}	0.13336	3.325	0.00462

Multiple $R^2 = 0.7242$

APPENDIX 2: MAJOR LEGAL CHANGES BY YEAR

Year	Legislation	Major Cases	Citation
1870	1870 Revision		16 Stat. 212 (1870)
1879		Baker v. Selden	101 U.S. 99 (1879)
1884		Burrow-Giles v. Sarony	111 U.S. 53 (1884)
1886	Berne Convention (no U.S.)		
1891	International Copyright Treaty		26 Stat. 1106 (1891)
1897	Act of Jan. 6, 1897		29 Stat. 481 (1897)
1902	International Copyright Convention		35 Stat. 1934 (1902)
1903		Bleistein v. Donaldson Lithographing Co.	188 U.S. 239 (1903)
1908		White-Smith Music Publ'g Co. v. Apollo Co.	209 U.S. 1, 15 (1908)
1908		Bobbs-Merrill Co. v. Straus	210 U.S. 339, 346 (1908)
1909	Act of 1909		35 Stat. 1075 (1909)
1912	Act of Aug. 24, 1912 (Townsend Amendment)		37 Stat. 488 (1912)
1917		Herbert v. Shanley	188 U.S. 239 (1917)
1919	1919 Retroactive Protection Search Term End and Ad Interim Amendment		41 Stat. 368 (1919)
1930		Nichols v. Universal Pictures Corp.	45 F.2d 119 (1930)
1939		Washingtonian Pub. Co. v. Pearson	306 U.S. 30 (1939)
1941	Act of Sept. 25, 1941		Pub. L. No. 77-258, 55 Stat. 732 (1941)
1953	Act of July 17, 1952		Pub. L. No. 82-575, 61 Stat. 653 (1952)
1954		Mazer v. Stern	347 U.S. 201
1954	Effective Date of Universal Copyright Convention		68 Stat. 1030 (1954)

1962	Act of Sept. 19, 1962.		Pub. L. No. 87-668, 76 Stat. 555 (1962)
1964		Sears, Roebuck & Co. v. Stiffel Co.	376 U.S. 225 (1964)
1964		Compco Corp. v. Day-Brite Lighting, Inc.	376 U.S. 234 (1964)
1971	Feb. 15, 1972, Effective Date of Act of Oct. 15, 1971		Pub. L. No. 92-140, 85 Stat. 391 (1971)
1973		Williams and Wilkins v. United States	487 F.2d 1345 (1973)
1974	Geneva Phonograms Convention, (Effective Date March 10, 1974) (Convention for the Protection of Producers of Phonograms)		25 U.S.T. 309 (1974)
1974	July 10, 1974, U.S. Adhered to 1971 Paris Revision of Universal Copyright Convention		Revised Universal Copyright Convention: Hearing on Ex. G. Before the Comm. on Foreign Relations of the United States Senate, 92d Cong., 2d Sess. (1972); S. Exec. Rep. No. 92-32, 92d Cong., 2d Sess. (1972)
1976	1976 Copyright Act		Pub. L. No. 94-553, 90 Stat. 2541 (1976)
1980	Computer Software Copyright Act		P.L. 96-517, 94 Stat. 3015, 3028 (1980) (amending 17 U.S.C. §§101, 117 (1976))
1982	Act of May 24, 1982		Pub. L. No. 97-180, 96 Stat. 91 (amending 18 U.S.C. § 2318 & 17 U.S.C. § 506(a))
1984	Semiconductor Chip Protection Act		Pub. L. No. 98-620, 98 Stat. 3347 (1984)
1984	Record Rental Amendment		Pub. L. No. 98-450, 98 Stat. 1727 (1984)
1984		Sony Corp. of America, Inc. v. Universal City Studios, Inc.	464 U.S. 417 (1984)
1985		Harper & Row, Publishers, Inc. v. Nation Enter.	471 U.S. 539 (1985)
1986	Manufacturing Clause of Copyright Act Expires		
1988	Berne Convention Implementation Act		Pub. L. 100-568, 102 Stat. 2853 (1988)

1988	Satellite Home Viewer Act		Pub. L. 100-667, 102 Stat. 3949 (1988)
1989		Community for Creative Non-Violence (CCNV) v. Reid	490 U.S. 730 (1989)
1990	Visual Artists Rights Act (VARA)		Pub. L. 101-650, 104 Stat. 5128 (1990)
1990	Architectural Works Copyright Protection Act (AWCPA)		Pub. L. 101- 650, 104 Stat. 5133 (1990)
1990		Stewart v. Abend	495 U.S. 207 (1990)
1991		Feist Publications, Inc. v. Rural Telephone Service Co., Inc.	499 U.S. 340 (1991)
1992	Copyright Amendments of 1992 (Automatic Renewal Act of 1992)		Pub. L. No. 102-307, 106 Stat. 204 (1992)
1992	Audio Home Recording Act		Pub. L. No. 102-563, 106 Stat. 4237 (1992)
1994	Uruguay Round Agreements Act (URAA)		Pub. L. No. 103-465, 108 Stat. 4809 (1994)
1994		Campbell v. Acuff Rose Music, Inc.	510 U.S. 569 (1994)
1995	Digital Performance Right in Sound Recordings Act		Pub. L. No. 104-39, 109 Stat. 336 (1995)
1997	No Electronic Theft Act (NET)		Pub. L. 105-147, 111 Stat. 2678 (1997)
1998	The Sonny Bono Copyright Term Extension Act (Copyright Term Extension Act) (CTEA)		Pub. L. No. 105-298, 112 Stat. 2827 (1998)
1998	Digital Millennium Copyright Act (DMCA)		Pub. L. No. 105-304, 112 Stat. 2860 (1998)
1999	Digital Theft Deterrence and Copyright Damages Improvement Act		Pub. L. No. 106-160, 113 Stat. 1774 (1999)
2001		New York Times Co., Inc. v. Tasini	533 U.S. 483 (2001)
2002	Small Webcaster Settlement Act		Pub. L. No. 107-321, 116 Stat. 2780 (2002)
2003		Eldred v. Ashcroft	537 U.S. 186 (2003)
2005	Family Entertainment and Copyright Act		Pub.L. No. 109-9, 119 Stat. 218 (2005)
2005		MGM Studios Inc. v. Grokster, Ltd.	545 U.S. 913 (2005)

APPENDIX 3: TECHNOLOGICAL MILESTONES BY YEAR

Year	Technological Milestones	
1877	Edison invented sound recording	
1878	Dry plates commercially manufactured for photography	
1879	Edison invented light bulb	
1880	Founding of Eastman Dry Plate	
1882	First electric power station	
1885	Linotype and monotype print developed	
1888	Invention of Gramophone;	First Kodak Camera
1889	Rotary presses demonstrated	First Kodak film roll camera
1890	Edison invented first motion picture camera Kinetograph	
1891	Edison invented Kinetoscope (1 viewer)	
1895	Marconi developed radio	Edison introduced inetophones
1896	First theatrical use of Edison vitascope	
1897	Braun invented cathode-ray tube	
1900	Kodak Brownie camera introduced	
1906	Panchromatic black and white film available	Invention of the audio vacuum tube
1907	Color film commercially available	
1913	35mm still camera	
1920	First commercial radio began daily broadcast	
1921	First feature film to use sound	
1924	First cartoon with soundtrack	
1926	First "talkie" film	
1927	Flash bulb invented	Movietone soundtrack developed
1928	First television station	
1931	Strobe photography	
1932	First Technicolor movies	
1935	First practical magnetic tape recorder	
1936	Kodachrome developed	
1938	Sale of first all-electronic television set	
1941	NTSC standard adopted	First commercial FM Station
1943	First stereo tape recorder	
1946	Introduction of audiotape	First cable television transmission
1947	Invention of the transistor	
1950	Photocopying commercially available	9 percent of households with TV
1953	Color television transmission began	
1956	Videotape recording demonstrated	
1962	Telstar television satellite launched	90 percent of households with TV
1963	Cassette recorder invented	Color instant film developed
1965	Sony Betamax introduced	
1967	Sony introduced first portable video recorder	
1968	Sony develops Trinitron tube	
1969	Arpanet	
1972	Intelsat system launched	Digital audio recording
1973	Internet protocol developed	
1975	Laser printer	
1976	Personal computers developed	Ink jet
1978	First autofocus camera	98 percent of households with TV

1979   Walkman
1980   Compact Disc invented   CNN launched; first camcorder
1984   First digital still camera
1989   High definition television
1990   Adobe Photoshop released
1995   World Wide Web becomes most-used Internet service (exceeding telnet and ftp);
       MP3 codec invented; DVD
2001   iPod