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INTELLECTUAL PROPERTY RIGHTS, INNOVATION IN DEVELOPING COUNTRIES, AND COPYRIGHT TERM EXTENSION

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To my mom and dad.

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Abstract

This thesis explores the interrelationship between the intellectual property rights (IPRs) and technological changes. In unraveling the causality, it was found that the relationship between IPRs and technological changes is largely a mutually fostering one. On one hand, the IPRs help promote innovations. On the other hand, IPRs are institutions developed endogenously in response to the rapid technological changes. This interrelationship is manifest in copyrights and patents - industrialists argue that patents lead to more innovations by locking in competitive advantages for companies that take technological lead, while copyright becomes longer and stronger when new technologies facilitating faster distribution become easier to access.

Each of these relationships is relegated to one chapter for detailed examination. In the first chapter, I extended Helpman (1993) model by incorporating the innovations in developing countries. As a result, I found both positive and negative effects depending on the relative population size and current rate of innovation, as opposed to Helpman's finding of negative effect only.

The second chapter explores the next aspect of the relationship. A concept of cost of expression advanced by Landes and Posner in (1989) is one of the pillars of the model on copyright. I find that an optimal path over time should be a stronger copyright protection when new technologies are introduced followed by a relaxed protection after technologies stop to advance. Additionally, when experiencing the same technological shock, countries with lower works of authorship to begin with need to strengthen the copyright protection to a greater extension compared with the countries having more works of authorship.

In Chapter Three, I conduct a case study on the US Sonny Bono Copyright Term Extension Act (CTEA) passed in 1998. In this study, the previously mentioned two issued are again addressed – the affect of copyright term extension on future creations, and the justification of extension due to technological changes. In this chapter, no adequate economic rationale for the extension was found. Although some of the factors are difficult to measure, it seems that the costs outweigh the benefits of the copyright term extension.

Introduction

The intellectual property laws evolved against the backdrop of rapid industrial revolution and technological changes. The patent law protects new and useful processes, machines, manufacture, or composition of matters, or any new and useful improvement thereof[1]. Copyright laws grew out of *de facto* monopolies which developed along with the establishment of presses[2]. The common law of trademark arose originally to prevent manufacturers from trying to pass off their goods as someone else's. The grant of a right to a certain mark involved recognition of the need to protect the good will which a manufacturer may develop in his customers[3].

All these three major categories of intellectual properties retain an element of shielding the innovators or producers from unpermitted use or sales of their products, ideas or expressions, as means to foster further development or manufacture of these. Intellectual property laws were devised in the spirit of incentivising technology developers to endeavor into their undertakings to come up with more works of creation benefiting the society. What is intriguing to me here is the interaction between the *intellectual property rights (IPRs)* and *technological changes*. On one hand, it seems the IPRs help promote innovations. On the other hand, IPRs are institutions that themselves are endogenously developed in response to the rapid technological changes, in past few centuries in particular. This shows an interesting mutually fostering chicken-and-egg relationship between technological changes and IPRs. The modern IPR systems came into effect only a few centuries ago with the industrial revolution and the mercantilism being the underlying driving forces. Once the IPRs are in force, they did play a vital role in helping

[1] U.S. Patent Act, Sec. 101
[2] Koepsell, David R. The Ontology of Cyberspace: Philosophy, Law, and the Future of Intellectual Property. Peru, Illinois: Open Court Publishing, 2000.
[3] Ibid.

producers to recover investments and undertake further innovations. This interrelationship is manifest in copyrights and patents - industrialists argue that patents lead to more innovations by locking in competitive advantages for companies that take technological lead, while copyright becomes longer and stronger when new technologies facilitating faster distribution of cultural and artistic works, such as press, photocopiers, internet, etc. become easier to access.

It should be noted that a sophisticated approach should be employed to treat both technology and IPRs as endogenous variables. While recognizing this important issue of endogeneity, I choose to decompose this problem and separate it into two issues to simplify the analysis. One is an investigation of the impact of IPRs – as a planner's choice variable - on technological changes. The other is to regard technological changes as exogenous and examine its effect on optimal IPRs.

Chapter One follows the first line. It is a direct extension of Helpman (1993) - one of the seminal studies on IPRs. Helpman (1993) found negative impact of IPRs on innovation. Counterintuitive as it seems, the reason for this is that the innovating sector in the North – or developed countries – has lower costs due to stronger IPRs. However, the profit rate decreases more than the decrease of effective cost due to the increased production share. This leads to lower rate of innovation in the long-run. In the first chapter, I explicitly model the innovation and imitation activities at the same time in the South – or developing countries – to better reflect the reality, and meanwhile expect that the negative impact of IPRs in Helpman (1993) may be changed. As a result, I do find conditionally positive impact on world technological changes.

In Chapter Two, contrasting Chapter One, I take IPRs, - copyright in this case - as endogenous. I am interested in exploring the pattern of change of copyright when technologies – especially those that

facilitate low-cost dissemination – are being developed. I find that an optimal path over time should be a stronger copyright protection when new technologies are introduced followed by a relaxed protection after technologies stop to advance. In addition to this, when experiencing the same technological shock, countries with lower works of authorship to begin with need to strengthen the copyright protection to a greater extension compared with the countries having more works of authorship.

In Chapter Three, I conduct a case study on the US Sonny Bono Copyright Term Extension Act (CTEA) passed in 1998. The CTEA extended copyright term of protection for 20 more years. Among others, for works of single authors, the protection was extended from 'author's life plus 50 years' to 'author's life plus 70 years'. In this study, the previously mentioned two issued are again addressed – the affect of copyright term extension on future creations, and the justification of extension due to technological changes. In this chapter, no adequate economic rationale for the extension was found. Although some of the factors are difficult to measure, it seems that the costs outweigh the benefits of the copyright term extension.

Admittedly, intellectual property right issues are sometimes complicated to tackle using only one approach as they often involve economic, political, legal, international and even philosophical concerns. While I touch upon and discuss other dimensions, my primary approach is economic. As a result, many issues and concerns may seem to be left out of the study, and it should not be surprising if economics-oriented methodology generates views that seem biased or contradictory to what other disciplines may bring about. In addition, I should humbly admit that economic approach has its own limitations. Although difficult, it would be the most desirable to take considerations of other disciplines into account and strive to find ways to incorporate them since frequently, one finds refreshingly new ideas from other fields of studies.

I hope that this present study moves us forward in understanding the nature of intellectual property right and its interaction with technological changes over time.

Last but not least, during the writing of the dissertation I have received generous and wonderful support from my committee members. I could not have completed this dissertation without them. I am especially thankful to the chair of my dissertation, Professor Sumner La Croix for his bright insights, patience and encouragement. His guidance and instruction are crucial to my successful completion of this study. Professors Theresa Greaney, Denise Konan, James Moncur and Kate Zhou have all provided wonderful comments, critique and support to my study. I am deeply grateful to them.

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CHAPTER I:

Intellectual Property Rights Protection and Global Technological Change

Abstract

Within a dynamic framework, a model is set up to analyze the affects of IPR protection on the technological innovations both in developed countries and developing countries. This paper departs from the existing literature in that the indigenous inventive activities, which were largely ignored by previous IPR research, are explicitly incorporated and assumed to take place simultaneously with the production of imitated North-invented products. The model implies that in the equilibrium, the northern innovation rate responds negatively to tightened IPR protection while the affect on Southern rate of innovation is ambiguous, depending on such factors as the population differential and initial strength of protection. This generates a possibility of gross positive impact on long-term technological innovation which was not generally found in previous research using similar approach. In particular, the overall positive response can occur if the population of the developing region is larger than that of the developed region and the rate of imitation is small.

I. Introduction

Policy-makers have made swift progress on the protection of Intellectual Property Rights (IPRs) exemplified by Trade-Related Aspects of Intellectual Property Rights (the TRIPs Agreement) at the Uruguay Round of GATT/WTO negotiations. Although countries vary to a great extent in actual law enforcement, most of them adopted minimum level of IPR protection required by the TRIPs. Admittedly, research findings are behind policy advancement in this area. Developing countries have essentially emphasized the static affect that will in the short-run transfer monopoly rent to the technologically developed countries, in exchange for more liberalized primary goods market (like textile etc.) where developing countries have comparative advantage.

Negotiations proceeded without adequate theoretical affirmation as to how the heightened IPR protection will affect world welfare, technological change etc. Most studies have focused on examining the role of IPRs in the setting of technological transfer from the North, the inventing countries to the South, the technology receiving countries.

Some of the important studies that employed dynamic general-equilibrium approach (Helpman (1993)) have found that increased level of IPR protection tends to hamper long run technological innovation. Meanwhile, mixed results are found in studies using other approaches. For instance, Zigic (1998) and Reinganum (1982) developed game-theoretic models where positive effects of IPR protection on technical changes are found.[4] Using static approaches, Markusen (2001), Diwan and Rodrik (1991) found positive effects while Deardorff (1992) concluded with the pessimistic view of negative effects.

[4] Reinganum's study was dynamic in nature. However, no international interaction was taken into account.

Majority of the existing studies presumed that inventive activities take place in certain countries (usually named North) before being transferred to the rest of the world (South). However, as was observed in the Newly Industrialized Economies, indigenous technical changes took place throughout the developmental process. These changes undergo an increasing trend and were elevated by technology transfer (through imitation, licensing and foreign direct investments etc.) from abroad. An effective IPR system has an important role to play as to foster the development and use of "more appropriate" technology in at least some industries (La Croix (1992), Braga, Fink and Sepulveda (2000), Chin and Grossman(1990)).

Theoretical studies again were limited concerning technological changes in the developing countries. Chou and Shy (1991) and van Elkan (1996) introduced a possibility of innovation of an imitating economy after a certain technological threshold was reached. However, there was no treatment of IPRs in these works. Tamirisa and Konan (1997) modeled in a dynamic general equilibrium framework that weak IPR protection and high imitation rate would allow the initially knowledge-scarce imitating region to close the knowledge gap and switch to innovation, at which time it emanates an incentive for higher IPRs. Lai and Qiu (2000) explicitly introduced southern innovation in their multi-sector model. They found that developing countries adopting an IPR standard as stringent as that of the North can benefit both regions provided that the North concedes in other sectors.

The present paper is motivated by the general equilibrium studies mentioned above, most of which led to the conclusion that tighter IPR protection in the developing countries will result in a downward trend of long-run world technological innovation. In this paper I complement the existing research by incorporating the technical changes taking place in developing countries throughout the developing process. We would expect a possibility that the downward trend is altered by doing so.

A model of endogenous technical innovation is developed in the style of Helpman (1993) and Grossman and Helpman (1991). It departs from them in that the initial pace of innovation in South is non-zero. However, it is slower than that in the North. This setting allows us to observe the contribution of the southern innovation to the world technological change and the role that IPR protection plays. Imitation is the only channel of technology transfer and innovation is variety-increasing. The economies will converge to equilibrium where the rates of innovation and production allocation are constant. Each product is sold in a monopolistic market. Once imitation is successful, a northern monopoly loses the market to a low-cost southern monopoly. IPR protection comes into play to regulate the rate of imitation in the South which affects northern innovations, world knowledge base, and southern innovations. IPRs in the North are fully protected. We found that the impact of IPR protection on the long-run technical change depends on the population of each region and the rate of imitation. If the population of the South is smaller, the impact is negative. However, if it is larger and the imitation rate is lower than a critical point, tightened IPR protection could generate a positive impact. Nevertheless, if the imitation rate is higher than that point, negative effect will be observed.

The asymmetry between the two industries of the South in this model should be expected to generate wage differential in the South, or at least cause a wage movement in the dynamic setting. Presumably, different industries engaging in different activities – especially when one is innovating and the other is producing imitated goods – should generate diverging wage rate. However, to simplify the analysis I carried over the assumption in Helpman (1993) that the wage rate is constant over time and equal across industries in the South. Since I extended Helpman(1993) in an major way by adding in an innovating sector to the Southern economy, the wage rates in the South should ideally be allowed to freely adjust. Admittedly, in an important way this model is not a general-equilibrium study in which wage rates are

endogenous. A more sophisticated study should take the wage movement into account and this will be left for future research.[5]

The paper is organized as follows: the model is introduced in section 2. Section 3 characterizes the properties of equilibrium and presents major comparative static results. Section 4 concludes.

II. Model

I consider a two-country economy, an innovating North and, a country named South, that undertakes both innovating and producing imitated goods.

In the South, the imitating sector will use costlessly obtained blueprints -- or blueprints from heaven -- to produce. In this model, imitation is a random process rather than a firm activity; the process of imitation does not employ any labor; only the production of the good requires labor. The rest of the labor force is employed by the innovating sector in either production or innovating activities.[6] At the firm level, we assume that the two production processes can take place within one firm or in separate entities. The two sectors generally do not interact with each other and there are no economies of scale as far as the two sectors are concerned. They are related only in the sense that the inter-sector labor flow has to satisfy the labor constraint. Therefore, there will be no real effects resulting from the manner in which the two activities are organized.

[5] Thanks to Dr. Denise Konan and Dr. Theresa Greaney for pointing this out.
[6] Assuming labor can engage in innovation without further cost of training.

Blueprints are assumed not to further flow to the innovating sectors, therefore, profit rates will not be equalized across sectors; the imitating sector has higher profits, but firms cannot choose to be imitators — as the blueprints randomly fall from heaven. This somewhat arbitrary assumption is used to reflect the real world where innovating and imitating sectors co-exist. In reality, the two sectors may co-exist for a variety of reasons. For instance, the differing technological or financial endowments, market segmentation or technological factors giving innovators market power, imbalanced IPR protection favoring domestic producers and transaction costs, etc. may lead to this symbiotic state. The rate of imitation m, determined by the strength of IPRs, dictates that the blueprints available at each point in time are limited and exogenous. In specifying the rate of imitation, I carried over the approach used in Helpman (1993). As admitted therein, "We may interpret in this model a tightening of intellectual property rights as a decline in the rate of imitation; … This view is, of course, incomplete, because it does not specify the mechanism through which government policies affect the rate of imitation."[7]

g^N, g^S and g are the rates of innovation of North, South and the world, respectively. $\dot{n}^N + \dot{n}^m$, $\dot{n}^S$ are new products invented by North and South. However, part of Northern inventions $\dot{n}^m$ will be imitated and produced by the South.

$$g^N = \frac{\dot{n}^N + \dot{n}^m}{n} \tag{1}$$

$$g^S = \frac{\dot{n}^S}{n} \tag{2}$$

[7] See Helpman (1993)

$$g = g^S + g^N = \frac{\dot{n}^N + \dot{n}^m + \dot{n}^S}{n} = \frac{\dot{n}}{n} \tag{3}$$

South will be producing n^S and n^m, while North produces n^N. Therefore, production shares of the South and North in the world economy are $\zeta^N = \frac{n^N}{n}$ and $\zeta^S = \frac{n^S + n^m}{n}$, respectively. The hazard rate of being imitated is:

$$m = \frac{\dot{n}^m}{n^N} \tag{4}$$

The aggregate rate of imitation m is systematically regulated and dictated by IPRs. To firms, the rate of imitation is exogenous and is assumed to have little bearing on the firms' internal behavior.

In each period of time, blueprints of products developed in the North randomly fall into the hands of firms in the South that pay lower wages to labor than Northern firms. Since Southern firms have no blueprint costs and pay lower wages, they gain an absolute advantage over the Northern firms and will take over the entire production of the product. Northern firms whose products are successfully imitated will have to shut down, and their labor will be reallocated to innovative enterprises in the North.

μ denote the strength of intellectual property right protection, imposed on the economy exogenously, the higher μ is, the lower the rate of imitation, i.e. $\frac{dm}{d\mu} < 0$. The above conditions imply that the differential equations for the Northern and Southern share of production in the entire world are as follows:

$$\dot{\zeta}^N = g^N - m\zeta^N - g\zeta^N \tag{5}$$

$$\dot{\zeta}^S = g^S + m(1-\zeta^S) - g\zeta^S$$

Let l^S and l^N denote the amounts of labor devoted to R&D in the South and North, respectively. a is the productivity parameter in innovation, which is assumed the same across two countries for simplicity[8]:

$$l^i = g^i a \qquad i = N, S \qquad (6)$$

Goods are manufactured with one unit of labor per unit output in both regions. The northern producer who invents a product can charge a monopoly price as long as his product has not been imitated. Southern market is assumed to be monopolistic for each product as well since every firm produces differentiated products. Hence the imitator is able to mark up the price as much as the northern monopoly does[9]:

$$p^i = \frac{1}{\alpha} w^i \text{ [10]}, \qquad \alpha < 1 \qquad i = N, S \qquad (7)$$

The value of new blueprints v^i should cover the R&D costs:

$$v^i = \frac{w^i a}{n} \qquad i = N, S \qquad (8)$$

substitute (7) into (8), we have:

---

[8] Equation (6) implies we assume knowledge flows freely across borders. Taking South as an example, $l^S = g^S a = \frac{n^{*S}}{n} a$, then we have $n^{*S} = l^S n / a$, which implies that South's ability to invent proportionally depends on the availability of products in the international market, in other words, it depends on the world knowledge base. Same applies to the North.

[9] It's assumed that imitated product is identical to the original product. Further imitation by either northern or southern competitor is discouraged since in the presence of sunk cost of innovation, further imitation will result in inability to recover fixed cost and thus net losses for all manufacturers. Alternatively, each country can be assumed to offer full protection to domestic innovations (Taylor 1994) when governments are sympathetic to the lobbying by indigenous innovators (La Croix 1992). Lax protection affects only the rate of imitations on foreign made products.

[10] Here our attention is confined to the "wide gap" case as discussed in Grossman and Helpman (1991). Wage rate in North is not only higher than that of the South, but is high enough to allow southern firm charge monopoly prices in the same manner as northern firms.

$$p^i = \frac{v^i n}{\alpha \cdot a} \qquad i = N, S \tag{9}$$

In light of (6), labor markets are cleared in both regions, each of which consists of R&D and production:

$$L^N = ag^N + x^N n^N \tag{10}$$

$$L^S = ag^S + x^S (n^S + n^m)$$

where x is the production of each differentiated product. Individuals in both regions have identical preferences. Their utilities are represented by:

$$U(t) = \int^{\infty} e^{-\rho(\tau - t)} \log u(\tau) d\tau \tag{11}$$

The instantaneous flow of utility is assumed to take CES structure:

$$u = \left[\int_0^n x(j)^{\alpha} dj \right]^{1/\alpha} \tag{12}$$

Agents in both regions maximizing utility subject to intertemporal budget constraints yields the following conditions:

$$\frac{\dot{E}^i}{E^i} = r^i - \rho \qquad i = N, S \tag{13}$$

The present model we are trying to solve involves five endogenous variables, g^N, g^S, g , ζ^N and ζ^S. The dynamic movements of two of them are dictated by equation (5). We now proceed to obtain the other three.

We shall examine each country separately. In North, financial arbitrage yields

$$r^N + m = \frac{\pi^N}{v^N} + \frac{\dot{v}^N}{v^N} \tag{14}$$

Equation (14) shows agents are indifferent between saving while enjoying certain interest rate adjusted by imitation risks, and investing in firms conducting R&D and producing goods, which generates a profit stream π^N and capital gain $\dot{v}^N$.

$$\pi^N = (1-\alpha)p^N x^N \tag{15}$$

profit per product is equal to the monopoly rent above the wage level, according to the market elasticity of demand as in Helpman (1993).

In light of (8) and (10), we have

$$\frac{\pi^N}{v^N} = \frac{(1-\alpha)p^N(L^N - ag^N)n}{p^N \alpha \cdot an^N}$$

$$= \frac{1-\alpha}{\alpha a}\frac{(L^N - ag^N)}{\zeta^N} \tag{16}$$

Totally differentiate $E^N = p^N x^N n^N$ and using (10), we have

$$\frac{\dot{E}^N}{E^N} = \frac{\dot{p}^N}{p^N} - \frac{\dot{g}^N a}{L^N - ag^N}$$

$$= \frac{\dot{v}^N}{v^N} + g - \left[\frac{\dot{g}^N a}{L^N - ag^N}\right] \tag{17}$$

By virtue of (13) and (14)

$$\frac{\dot{E}^N}{E^N} = \frac{\pi^N}{v^N} + \frac{\dot{v}^N}{v^N} - m - \rho$$

$$= \frac{1-\alpha}{\alpha a}\frac{(L^N - ag^N)}{\zeta^N} + \frac{\dot{v}^N}{v^N} - m - \rho \tag{18}$$

Now equating (17) and (18), we can solve for $\dot{g}^N$:

$$\dot{g}^N = \left(g^S + g^N + \rho + m - \frac{1-\alpha}{\alpha \cdot a} \cdot \frac{L^N - ag^N}{\zeta^N} \right)\left(\frac{L^N}{a} - g^N \right) \tag{19}$$

Similarly for South, we have the financial market equilibrium condition (for derivation, please refer to Appendix I):

$$\frac{\pi^S}{v^S} + \frac{\dot{v}^S}{v^S} = r^S - m\frac{(1-\zeta^S)}{\zeta^S} \tag{20}$$

Total expenditure can be expressed as follows:

$$E^S = p^S(n^S + n^m)x^S \tag{21}$$

$$\frac{\dot{E}^S}{E^S} = \frac{\dot{v}^S}{v^S} + g - \frac{\dot{g}^S a}{L^S - ag^S} \tag{22}$$

Combining (13), (20) and (22), we have:

$$\frac{1-\alpha}{\alpha a}\frac{L^S - ag^S}{\zeta^S} + m\frac{(1-\zeta^S)}{\zeta^S} - \rho = g^S + g^N - \frac{\dot{g}^S a}{L^S - ag^S} \tag{23}$$

solving for $\dot{g}^S$:

$$\dot{g}^S = \left(g^S + g^N + \rho - m\frac{(1-\zeta^S)}{\zeta^S} - \frac{1-\alpha}{\alpha \cdot a} \cdot \frac{L^S - ag^S}{\zeta^S} \right)\left(\frac{L^S}{a} - g^S \right) \tag{24}$$

Utilizing following relations:

$$g = g^N + g^S \tag{3}$$

$$\dot{g} = \dot{g}^N + \dot{g}^S \tag{3'}$$

$$\zeta^N + \zeta^S = 1 \tag{25}$$

$$\dot{\zeta}^N + \dot{\zeta}^S = 0 \tag{25'}$$

we obtain the dynamic system in terms of southern and northern rates of innovation and southern production share, respectively:

$$\dot{g}^S = \left(g^S + g^N + \rho - m\frac{(1-\zeta^S)}{\zeta^S} - \frac{1-\alpha}{\alpha \cdot a} \cdot \frac{L^S - ag^S}{\zeta^S} \right)\left(\frac{L^S}{a} - g^S \right) \tag{24}$$

$$\dot{g}^N = \left(g^S + g^N + \rho + m - \frac{1-\alpha}{\alpha \cdot a} \cdot \frac{L^N - ag^N}{1-\zeta^S} \right)\left(\frac{L^N}{a} - g^N \right) \tag{19}$$

$$\dot{\zeta}^S = g^S + m(1-\zeta^S) - (g^S + g^N)\zeta^S \tag{5}$$

We are now to characterize the equilibrium.

III. Equilibrium and Comparative Statics

Proposition 1:

There exists a saddle point equilibrium that the present dynamic system converges to.

Proof: please refer to Appendix II.

The system is depicted in figure 1.1 and figure 1.2,

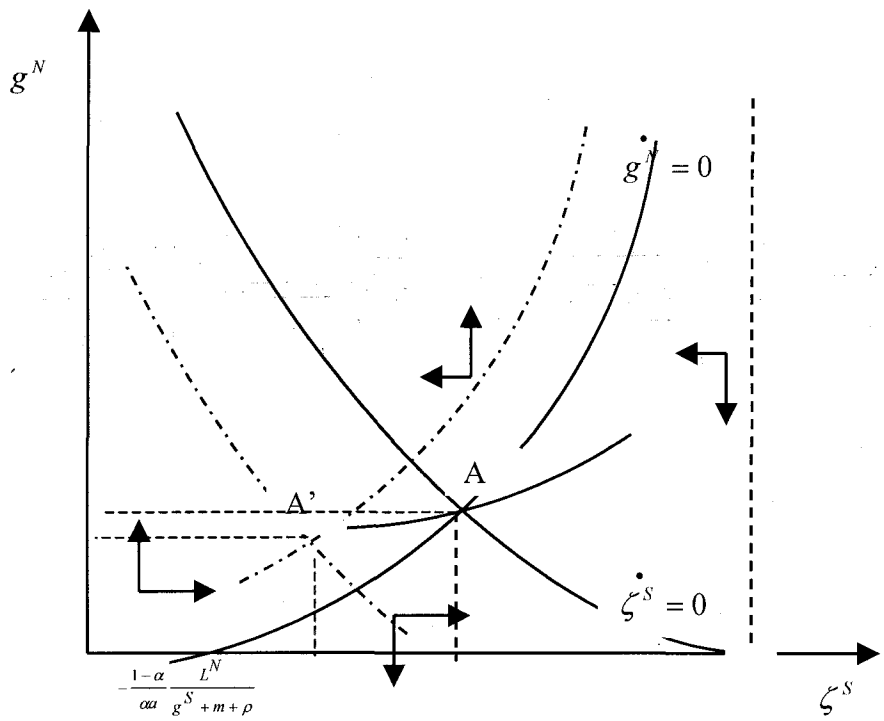

Figure 1 Comparative Statics when IPR strengthens

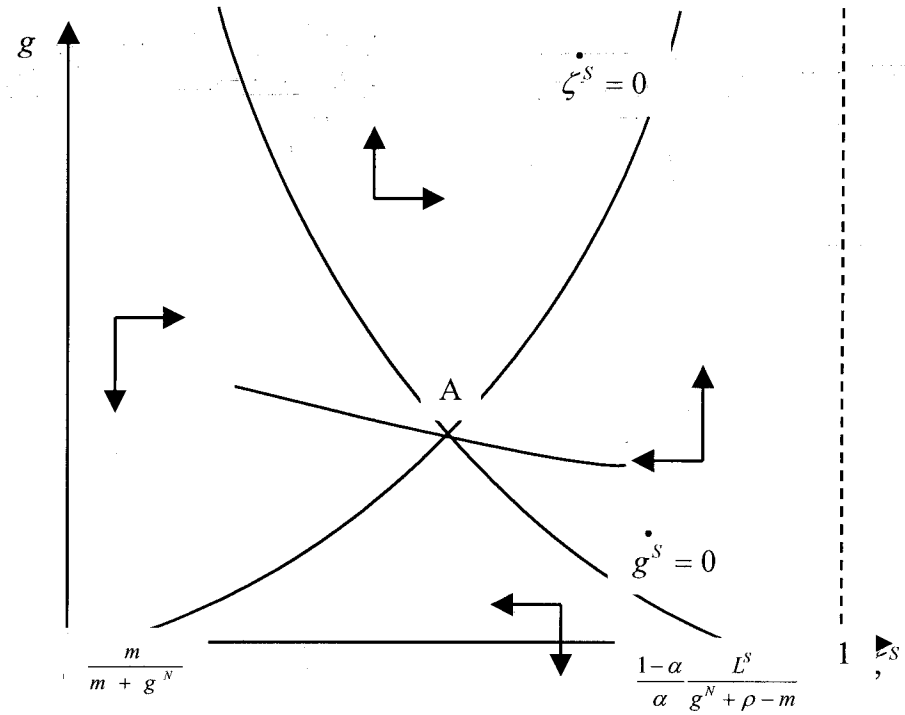

Figure 2 Saddle Path Equilibrium

At the steady state, the equilibrium must satisfy the following conditions. Since labor cannot be dedicated to R&D only, therefore $L^N - ag^N \neq 0$, $L^S - ag^S \neq 0$ and we have:

$$\dot{g}^S = 0 \quad \Rightarrow \quad g^{S*} + g^{N*} + \rho - m\frac{(1-\zeta^S)}{\zeta^S} - \frac{1-\alpha}{\alpha \cdot a} \cdot \frac{L^S - ag^{S*}}{\zeta^{S*}} = 0 \tag{26}$$

$$\dot{g}^N = 0 \quad \Rightarrow \quad g^{S*} + g^{N*} + \rho + m - \frac{1-\alpha}{\alpha \cdot a} \cdot \frac{L^N - ag^{N*}}{1-\zeta^{S*}} = 0 \tag{27}$$

$$\dot{\zeta}^S = 0 \quad \Rightarrow \quad g^{S*} + m(1-\zeta^{S*}) - (g^{S*} + g^{N*})\zeta^{S*} = 0 \tag{28}$$

As IPR strengthens in the developing country and m decreases, equation (27) and (29) imply that loci $\dot{\zeta}^S = 0$ and $\dot{g}^N = 0$ shift toward left. However, $\dot{\zeta}^S = 0$ shifts proportionally more than $\dot{g}^N = 0$ does, resulting in lower g^{N*} and ζ^{S*}. New equilibrium A' lies to the southwest of A, the equilibrium before IPR protection changes. In figure 2, $\dot{\zeta}^S = 0$ and $\dot{g}^S = 0$ shift leftward too, leading to lower ζ^{S*}. However, it is ambiguous which locus moves relatively more, therefore the movement of g^{S*} is indeterminate. The mathematical details are presented in Appendix III.

Equation (A.6) in Appendix III implies that the direction of the response has to do with the steady state southern production share ζ^{S*}. ζ^{S*} exceeding one half will lead to negative response of overall technological innovation to tightened IPR protection, while ζ^{S*} less than one half leads to positive response.

Solving the system (26), (27), (28) for ζ^{S*} and equating it to 1/2[11], we have

$$m^* \Big|_{\zeta^{S*}=1/2} = \frac{(L^S - L^N)(1-\alpha)}{a} \tag{29}$$

we observe from equation (29) that the steady state value of Southern production share ζ^{S*} also depends on the relative population of two regions.

[11] Since expression for ζ^{S*} is complex, we will not show it here though it can be obtained upon request.

The following figures reflecting steady state condition (A.1) depict the situations under different population distribution. As shown in Figure 1.3, if the population in the North is greater than or equal to that of the South, the value of m that leads to southern production share ζ^{S*} to equal 1/2 is non-positive. Since ζ^{S*} is a monotonically increasing function of m by (A.3), for any positive m (which is plausible value range), ζ^{S*} will be greater than 1/2, leading to $\frac{d(g^{S*}+g^{N*})}{d\mu} \leq 0$.

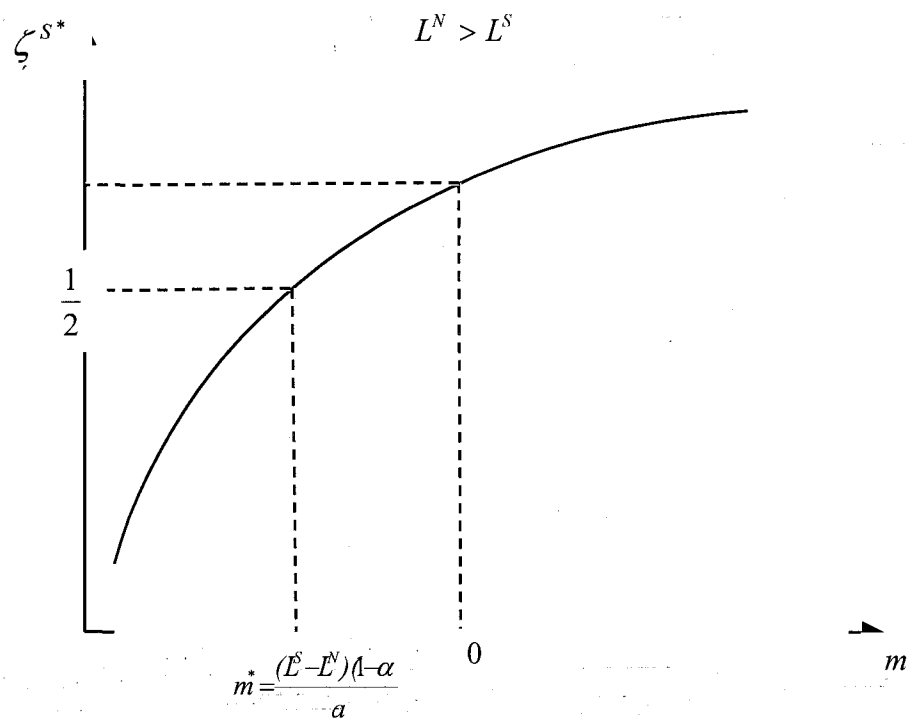

Figure 3 Value of Imitation Rate When Labor in the North is Greater than that of the South

In figure 1.4, if Northern population is less than that of the South, in contrast to Figure 1.3, m^* falls into the positive range. Further m greater than m^* leads to ζ^{S*} greater than 1/2, and a negative response of overall innovation to tighter IPR protection.

However, when m is less than m^*, ζ^{S*} is less than 1/2, resulting in $\frac{d(g^{S*}+g^{N*})}{d\mu} > 0$.

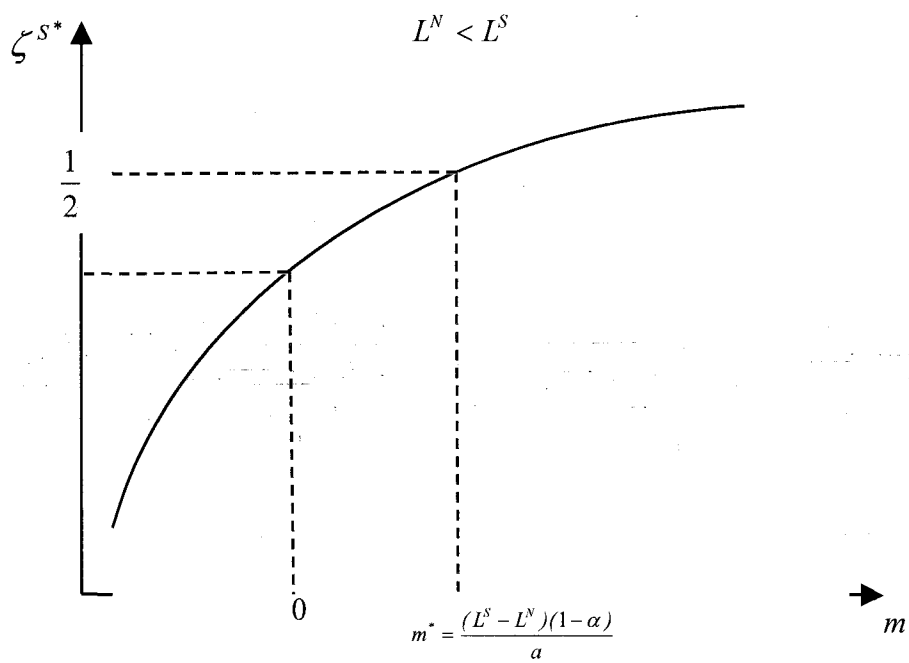

Figure 4 Value of Imitation Rate When Labor in the North is Less than that of the South

Proposition 2:

If the population of the North is greater than that of the South, the global technological innovation (combining the innovations in both regions) declines as the IPRs are strengthened. If the Northern population is less than the Southern population, the overall innovation response is negative if the rate of imitation is greater than m^* *and is positive if the rate of imitation is less than* m^*.

$L^N > L^S$	$m \in [0,+\infty)$	$\zeta^{S*} > \frac{1}{2}$	$\frac{d(g^{S*}+g^{N*})}{d\mu} < 0$
$L^N < L^S$	$m \in [0,m^*)$	$\zeta^{S*} < \frac{1}{2}$	$\frac{d(g^{S*}+g^{N*})}{d\mu} > 0$
	$m \in [m^*,+\infty)$	$\zeta^{S*} > \frac{1}{2}$	$\frac{d(g^{S*}+g^{N*})}{d\mu} \leq 0$

Table 1 Technological Change in Response to IPRs

Combining differential equations (27) and (28), and eliminating ζ^S, we have

$$g^S + g^N + \rho + m = \frac{1-\alpha}{\alpha \cdot a} \cdot (L^N - ag^N)\frac{g^S + g^N + m}{g^N} \tag{30}$$

Similarly, (26) and (28) yield:

$$g^S + g^N + \rho - m\frac{g^N}{g^S} = \frac{1-\alpha}{\alpha \cdot a} \cdot (L^S - ag^S)(1 + \frac{g^N}{g^S + m}) \tag{31}$$

These equations represent the steady state cost and benefit of production in the two regions. For instance, the left-hand side of equation (30) is the effective cost of capital for the North, inclusive of a risk premium – represented by the rate of imitation, the right-hand side is its profit rate (i.e. the inverse of the

price earning ratio, see equation (16)). The risk premium is negative for the South due to the fact that it stands a chance to imitate and take over the production of goods from the North, therefore its effective cost is lower than that of the North.

In steady state, as the IPRs are tightened, the rate of imitation m will decrease, leading to an imbalance of the above two equations. In particular, both cost and profit of the North will decrease, as is shown in (30). The cost is lower because the threat of being imitated and taken over is lessened. The profit per product (on each blueprint) is lower as well in that as threat is reduced, more resource is attracted to the innovative activities, the labor left for real production diminishes, therefore, not as many goods are produced of each type of product, hence a lower profit rate per product. The previous discussion shows that it must be the case that the cost falls less than the decrease of profit, resulting in a lower rate of innovation in the long run. In the South, as the rate of imitation m declines, both the cost and profit will rise. The costs rise because there are less blueprints falling onto imitating firms. The profit rate also rises since there will be less *types* of product produced, hence more profit is made for each type of product. However, which increases to a greater extent is ambiguous. The previous analysis shows that, taking both equations into account, the total rate of innovation may increase, but only under certain conditions – i.e. when the Southern population is greater than that of the North and the rate of imitation m has to be lower than $\frac{(L^S - L^N)(1-\alpha)}{a}$.

Figure 1.5 summarizes the finding. In contrast to Helpman (1993), the present model, by considering the innovative activities in the South, implies that under certain conditions, the effect of IPRs on technological advance can be positive. In particular, when the population of the developing region is larger than that of the developed region and the rate of imitation is less than $\frac{(L^S - L^N)(1-\alpha)}{a}$, the overall

effect is positive. In addition, when the population gap is wide between the two regions, the m^* value is higher, which implies that tightening IPR protection is more likely to create a positive effect in this case. When the developing region's population is larger than the developed region's, the effect of IPRs is negative, same as what Helpman (1993) concludes.

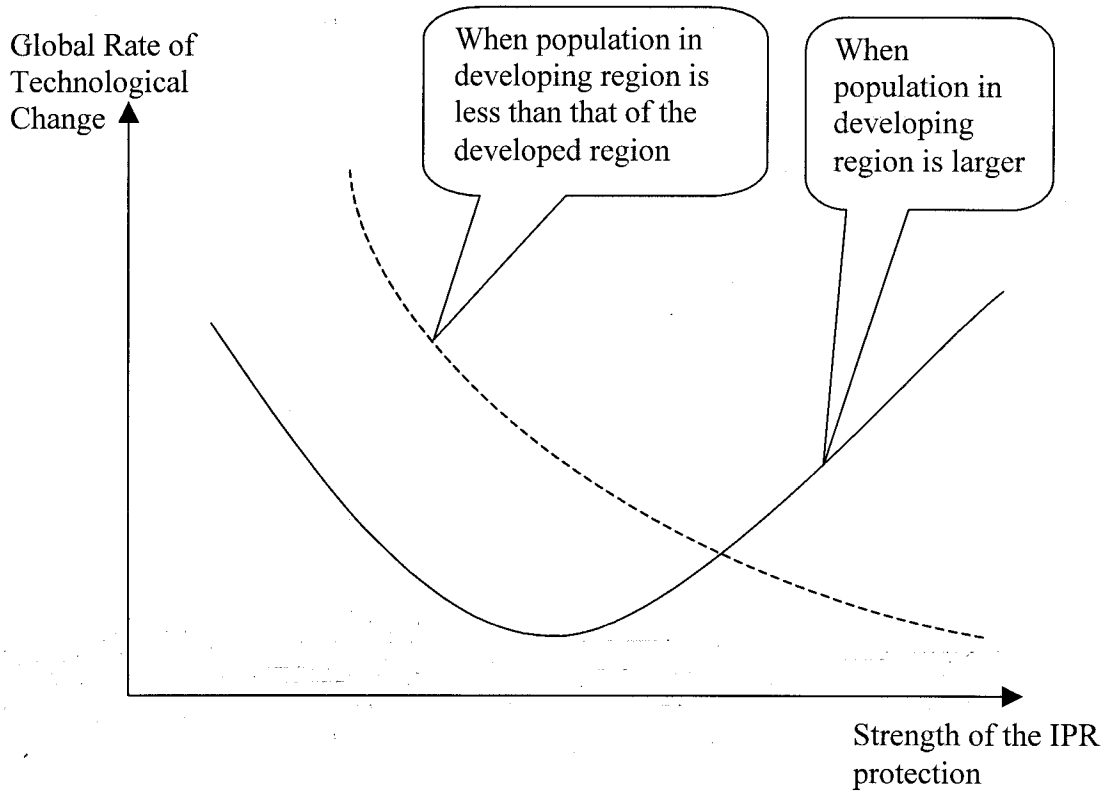

Figure 5 Technological Change in Different Regions

IV. Conclusion

I have developed a model of product varieties that explicitly takes into account the technological innovations in the developing regions. A dynamic framework is employed, which generates insights on changes over time. The model departs from the previous studies in that it produces a possibility of gross positive effect on technological change. I was able to observe that the IPR protection in the developing countries may have differing effects on the long-run world technological innovation depending on such factors as population and initial strength of protection (which determines the rate of imitation). In particular, if the population in the developing region is larger than that of the developed region and imitation rate is lower than a threshold value, we find positive impact of tightened IPR protection on global technological change. However, in the real world, we find that the developing countries tightening the IPR protection more often than not are under the pressure from the developed countries, which indicate un-permitted use of intellectual properties is so rampant that it has to be stopped. In cases like this, imitation rate is generally high and the marginal effect is more likely non-positive. We also find that the wider the population gap is (if developing countries' population is larger), we are more likely to find positive effects of IPR protection.

Based on Helpman (1993), the setup of present model departs from that of Helpman in two ways – that each of the Southern producer faces monopolistic market and the South consists of an innovating sector and a sector that produces imitated goods. An exercise was carried out to add in only monopolistic market structure to the South. The result is essentially intact from the Helpman's paper. Therefore, we may conclude that it is the new addition of innovating sector in the South that drives the result of the present model.

Admittedly, there are assumptions that have constrained the model in certain ways:

1. Each region's ability to develop new blueprints is proportional to the world knowledge base, as discussed in footnote 4. In fact, information is usually not readily available to the rest of the country, not to mention the rest of the world, partly due to the protection of the IPRs, ironically.

2. Imitation is the only channel of technological transfer in the model. Earlier studies have investigated licensing (Yang and Maskus (2001)), foreign direct investment (Markusen(2001)) etc. as possible ways for the South to gain technical know-how. Lai (1998) also detected distinct effects through different channels of transfer. Imitation is completely assumed to be exogenous and effortless following the specification of Helpman (1993).

3. The *ad hoc* assumption that blueprints after falling into the hands of some Southern producers do not further flow to the rest of the country is rather restrictive. An ideal specification would be to allow the Southern imitators to copy invention from both South and North. Rates of imitation for Southern and Northern goods can be the same or different depending on the assumption about the ease of imitating respective goods.

4. Wage rates are assumed to be constant in the South. The distinct activities of the two sectors in the South determine that a divergence of the wage rates in the South is likely to be the long-term outcome. The wages should ideally be treated as endogenous variables and be allowed to freely adjust. It might also be interesting to observe how the higher branch of the Southern wage rate may or may not catch up with that of the North.

A possible extension of this paper could be to measure the welfare changes of each region and the global change. One may also examine the catching-up possibilities. However, these tasks will require calculating explicitly the eigenvalues of the three dimensional system, which, although difficult, may be the next step to take.

Appendix I

The financial arbitrage condition in the South is represented by

$n^S \pi^S dt + n^S \dot{v}^S dt + mdt(v^S n^N + \pi^S dt\, n^N) = n^S r^S v^S dt$. It states that southern firms benefit not only from innovations on their own (the first term), but from imitative activities (the third term) and its ensuing monetary benefits (the design, capital gain and profit, respectively) (the second term) as well. Dividing by dt and n^S, as time tends to zero, we have $\pi^S + \dot{v}^S + mv^S \frac{n^N}{n^S} = r^S v^S$. Further dividing each side by v^S and substituting n^N and n^S by $1-\zeta^S$ and ζ^S, we have equation (20).

Appendix II

To determine the stability, the system (24), (19) and (5) is linearized around steady state:

$$\begin{pmatrix} \dot{g}^S - g^{S*} \\ \dot{g}^N - g^{N*} \\ \dot{\zeta}^S - \zeta^{S*} \end{pmatrix} = \begin{pmatrix} \left(1+\frac{(1-\alpha)}{\alpha\zeta^S}\right)\frac{L^S - ag^S}{a} & \frac{L^S - ag^S}{a} & \frac{1-\alpha}{\alpha}\frac{(L^S - ag^S)^2}{a^2\zeta^{S2}} \\ \frac{L^N - ag^N}{a} & \left(1+\frac{(1-\alpha)}{\alpha(1-\zeta^N)}\right)\frac{L^N - ag^N}{a} & -\frac{1-\alpha}{\alpha}\frac{(L^N - ag^N)^2}{a^2\zeta^{N2}} \\ 1-\zeta^S & -\zeta^S & -(m+g^S+g^N) \end{pmatrix} \begin{pmatrix} g^S - g^{S*} \\ g^N - g^{N*} \\ \zeta^S - \zeta^{S*} \end{pmatrix}$$

using steady state conditions (26), (27) and (28) to simplify the first matrix on the right hand side of the equation generates the coefficient matrix that determines the stability of the equilibrium:

$$\begin{pmatrix} \frac{L^S - ag^S}{a} + g^S + g^N - m + \rho & \frac{L^S - ag^S}{a} & \frac{1-\alpha}{\alpha}\frac{(L^S - ag^S)^2}{a^2\zeta^{S2}} \\ \frac{L^N - ag^N}{a} & \frac{L^N - ag^N}{a} + g^S + g^N + m + \rho & -\frac{1-\alpha}{\alpha}\frac{(L^N - ag^N)^2}{a^2\zeta^{N2}} \\ 1-\zeta^S & -\zeta^S & -(m+g^S+g^N) \end{pmatrix}$$

it's rather straight forward to show, even without calculating explicitly the expressions, that the determinant of first matrix on the right hand side of the equation is negative while the trace is positive. This implies there exist three characteristic roots, one negative, two positive. Therefore, the system converges to a saddle point.

In equation (27), as ζ^{S*} approaches one, g^{N*} tends to infinity. In equation (28), as ζ^{S*} nears zero, g^{N*} tends to infinity again. Hence, the two loci intersect once in the positive quadrant in figure (1), at any point left of $\dot{\zeta}^S = 0$ locus, ζ^S increases over time and at any point right of $\dot{\zeta}^S = 0$ locus,

ζ^{S*} decreases over time. Similarly, at any point above $\overset{*}{g}^N = 0$ locus, g^N will increase and at any point below $\overset{*}{g}^N = 0$, g^N will decrease.

In equation (26), as ζ^{S*} approaches zero, g^{S*} tends to infinity. In equation (28), as ζ^{S*} nears one, g^{S*} tends to infinity again. Therefore, the two loci intersect once in the positive quadrant in figure (2), at any point left of $\dot{\zeta}^S = 0$ locus, ζ^S increases over time and at any point right of $\dot{\zeta}^S = 0$ locus, ζ^S decreases over time. Similarly, at any point above $\dot{g}^S = 0$ locus, g^S will increase and at any point below $\dot{g}^S = 0$, g^S will decrease.

Therefore from different perspectives, in terms of (ζ^S, g^N) and (ζ^S, g^S) respectively in figure (1) and (2), the systems converges to a saddle point equilibrium.

Appendix III

Totally differentiating the system comprised of equation (26), (27) and (28), substituting in steady state conditions, we have

$$\begin{pmatrix} 1+\frac{1-\alpha}{\alpha\zeta^{S*}} & 1 & \frac{g^{S*}+g^{N*}-m+\rho}{\zeta^{S*}} \\ 1 & 1+\frac{1-\alpha}{\alpha(1-\zeta^{S*})} & -\frac{g^{S*}+g^{N*}+m+\rho}{(1-\zeta^{S*})} \\ 1-\zeta^{S*} & -\zeta^{S*} & -m-g^{S*}-g^{N*} \end{pmatrix} \begin{pmatrix} dg^{S*} \\ dg^{N*} \\ d\zeta^{S*} \end{pmatrix} = \begin{pmatrix} 1 \\ -1 \\ -(1-\zeta^{S}) \end{pmatrix} dm + \ldots \quad \text{(A.1)}$$

Let the determinant of the first matrix on the left be denoted as $|J|$, where

$$|J| = (-\frac{1}{\alpha})\frac{g^{S*}+g^{N*}-m+\rho}{\zeta^{S*2}} + (-\frac{1}{\alpha})\frac{g^{S*}+g^{N*}+m+\rho}{(1-\zeta^{S*})^2} - (m+g^{S*}+g^{N*})*$$
$$\left[\frac{1-\alpha}{\alpha}\left(\frac{1}{\zeta^{S*}}+\frac{1}{1-\zeta^{S*}}\right)+\left(\frac{1-\alpha}{\alpha}\right)^2\frac{1}{\zeta^{S*}(1-\zeta^{S*})}\right]<0 \quad \text{(A.2)}$$

which is apparently negative within reasonable ranges of variable values. By Cramer's Rule, $\frac{d\zeta^{S*}}{dm}$, $\frac{dg^{N*}}{dm}$ and $\frac{dg^{S*}}{dm}$ represent the effects of imitation rate on steady state values of these endogenous variables, respectively. Since our central concern is the movement of these variables in response to tighter IPR protections, further calculations supply:

$$\frac{d\zeta^{S*}}{d\mu} = -\frac{d\zeta^{S*}}{dm} = -\frac{(2+\frac{1-\alpha}{\alpha\zeta^{S*}})(-\frac{1}{\alpha})}{|J|} < 0 \quad \text{(A.3)}$$

$$\frac{dg^{N*}}{d\mu} = -\frac{dg^{N*}}{dm} = -\frac{(2+\frac{1-\alpha}{\alpha\zeta^{S*}})(-\rho)}{|J|} < 0 \quad \text{(A.4)}$$

$$\frac{dg^{*S}}{d\mu} = -\frac{dg^{*S}}{dm} = -\frac{X}{|J|} \quad \text{(A.5)}$$

where $X = -(2 + \frac{1-\alpha}{\alpha(1-\zeta^{S*})})(m + g^{S*} + g^{N*}) + \frac{g^{S*} + g^{N*} + m + \rho}{1-\zeta^{S*}}(1 - 2\zeta^{S*}) + \frac{g^{S*} + g^{N*} - m + \rho}{\alpha\zeta^{S*}}$

Equation (A.3) and (A.4) echoes the pattern we observe in figure 1 that southern production share and northern innovation rate react negatively to higher level of IPR protection, however, equation (A.5) shows that the movement of southern rate of innovation g^{S*} is ambiguous. Since we are more interested in global welfare change and assume there exist adequate means to transfer income across countries[12], we shall examine the total effect of IPR protection on global innovation rate. We denote the sum of numerators in $\frac{dg^{N*}}{d\mu}$ and $\frac{dg^{S*}}{d\mu}$ as NM.

By (A.4) and (A.5), further simplification shows

$$NM = -[(m + g^{S*} + g^{S*} + \rho)(\frac{1-2\zeta^{S*}}{\zeta^{S*}(1-\zeta^{S*})}) + (m + g^{S*} + g^{S*})(\frac{1-\alpha}{\alpha}(\frac{1}{\zeta^{S*}} - \frac{1}{1-\zeta^{S*}}))] \quad \text{(A.6)}$$

$$\gtrless 0$$

Therefore, if $\zeta^{S*} < \frac{1}{2}$, then $NM < 0$, $\frac{dg^{S*}}{d\mu} + \frac{dg^{N*}}{d\mu} > 0$. If $\zeta^{S*} > \frac{1}{2}$, then $NM > 0$,

$$\frac{dg^{S*}}{d\mu} + \frac{dg^{N*}}{d\mu} < 0$$

[12] One possibility is the multi-sectoral negotiation as happening in TRIPs and as modeled in Lai and Qiu (2000).

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CHAPTER II:

Dynamic Copyright Protection and Technological Change

Abstract

The present essay builds upon the notion of Landes and Posner (1989) that excessively stringent copyright protection tends to increase the "expression cost" for ensuing creations in a society. It extends the modeling of copyright into a dynamic analysis. Since copyright is viewed as a choice variable set by the government to maximize social welfare over time, a dynamic optimal control framework is employed. The model implies that as the economy grows, copyright should be relaxed gradually on the time-path converging to the steady state. However, when technological changes that reduce copying costs -- facilitating low-cost dissemination of copyrightable material -- shock the system then the model shows that copyright protection needs to increase in strength temporarily before relaxing to a new steady state. Therefore, constant shocks may generate a seemingly continuous tightening pattern. In addition, the model also implies that economies that have lower number of copyrightable works should strengthen their protection to a higher extent when experiencing the same technological changes.

I. Introduction

In current literature, only a few studies have been dedicated exclusively to examining the nature of copyright protection. Among most studies, intellectual property rights (IPRs) are viewed as a whole or patents representing the entire family of IPRs, with less attention paid to the nature of copyright or the difference between copyright and patent. Being two largest categories in the intellectual property right, copyright and patent are distinct from each other. Copyrights are usually assigned to artistic, literary, entertainment works of authorship. Patents are given to such innovation as a new product or a process to produce industrial goods. Copyrights protect the expression of thoughts, visions and creations while patents protect the ideas behind an invention. However, it is usually not viable to model the above distinctions. A common approach to this problem is to stress the fact that both patent and copyright protection thwart the unrestricted/illegal use/access to the targeted material. Although it helps to highlight the important feature of intellectual property rights, it blurs the difference between patent and copyright. Previous studies have generally been unable to pick up these differences and distinguish the two except Landes and Posner (1989) that pointed out that the "expression cost" may be the key. Patent office requires that patentee "discloses" his invention to the public in return for the judicial protection. This has given the subsequent inventors easy access to technologies which may serve as a foundation for or simply inspire later innovations. This goes hand in hand with the ideas of Constitution framers who wrote that "the constitution grants Congress the power to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."[13]

[13] U.S. Constitution, Article I, §8, Clause 8.

Due to the nature of copyright, there is no disclosure clause attached to it (copyright will be pointless if protected works are "disclosed" or free to use). Therefore, more stringent copyright protection offers monopoly right to the copyright holders for limited time, during which period they are allowed appropriate revenues or permit or deny access depending on the strength of copyright protection.

University of Oregon librarian Christine L. Sundt confirms that some old-time images are of tremendous value to the art history teaching and research. These early images are significant in showing pre-restoration states of the art and as such are often more important in scholarship. Because these images have little commercial value, they languish with their rights attached so long as they are protected under copyright. Scholars have little hope of getting clearance because we can't find out the rightful owner and publishers are reluctant to accept images for which rights are not cleared.[14]

In 2002, a public television documentary by Davis Guggenheim was held up by attorneys who demanded a hefty licensing fee because two seconds of cartoon "The Simpsons" were shown playing on a television in one schoolhouse scene.[15]

Further, a much higher proportion than before of popular culture--especially for children--consists of corporate-owned, copyrighted images and characters whose use is carefully regulated. Kids who might once have performed school plays about Cinderella cannot do the same with Barbie, Barney, Daffy Duck or even Winnie the Pooh, all of whose copyright owners vigorously enforce their rights--in a few celebrated instances against elementary schools and summer camps.[16]

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[14] See http://www.studiolo.org/IP/CTEA/Chris.htm
[15] See http://www.charlotte.com/mld/observer/business/3086551.htm?1c
[16] Golden Eggs, Editorial in the Washington Post, April 27, 1998, see http://homepages.law.asu.edu/~dkarjala/OpposingCopyrightExtension/commentary/WPedit4-98.html

Further, the entire opening of Les Miserables (V. Hugo) in which a poor man steals from a priest and when he is caught and brought back by the police, the priest not only swears he has given him the items, but hands him silver candlesticks and says "you forgot these"... is originally an ancient Japanese Zen parable.[17] Had the Japanese instituted copyright protection centuries ago, and had it been long and universally recognized, we might have missed a great work of all times. In fact William Faulkner honestly stated that "good artist borrow each others idea's -- great artists steal them outright".

In fact, Shakespeare himself was a formidable "borrower" from former literatures. For instance, the famous description in *Antony and Cleopatra* of Cleopatra on her royal barge is taken almost verbatim from a translation of Plutarch's life of Mark Antony: "on either side of her, pretty, fair boys apparelled as painters do set forth the god Cupid, with little fans in their hands, with which they fanned wind upon her" becomes "on each side her / Stood pretty dimpled boys, like smiling Cupids, / With divers-colour'd fans, whose wind did seem / To glow the delicate cheeks which they did cool." In *The Waste Land*, T. S. Eliot "stole" the famous opening of Shakespeare's barge passage, "The barge she sat in, like a burnish'd throne, / Burn'd on the water" becoming "The Chair she sat in, like a burnished throne, / Glowed on the marble." Notice how literary creations had flourished when copyright is absent or expired.

The Amici Curae by the National Writer's Union et al. on the case of Eldred v. Ashcroft –where the plaintiff opposed copyright term extension from author's life plus 50 to 70 years -- corroborates the importance of unobstructed use of previous literature: "as the Register of Copyrights conceded in her Senate testimony, the positive incentive effects of the additional terms for new works are at best trivial. The additional protection will only take effect far in the future, when the present discounted value of any additional revenue is vanishingly small, to say nothing of highly uncertain. In contrast, through additional

[17] see http://cyber.law.harvard.edu/openlaw/eldredvreno/examples.html

access costs and problems in obtaining copyright clearances, the CTEA imposes immediate and significant disincentives on contemporary authors seeking to create new works."

The copyright expiration of *The Secret Garden* has spawned a huge outpouring of new and creative derivative works. A list of selected works is included in Appendix I. One might wonder how many of these works would be available, and at what price, if this classic work had not entered the public domain?[18]

In 1934 - a high point of the song *Home on the Range*'s commercial career - an Arizona couple, William and Mary Goodwin, claimed that the song infringed on the 1905 copyright in the Goodwins' song *An Arizona Home*. The couple later dropped their lawsuit when Samuel Moanfeldt, an investigator for the Music Publishers Protective Association, was able to produce evidence that the song had not originated with the Goodwins. This included a 1914 newspaper article which indicated that the words to the song had appeared in the Smith County (Kansas) Pioneer newspaper in 1873, affadavits from persons who claimed to have learned the song in the 1870s, 1880s, or 1890s, and a sound recording of the song as sung by Clarence Harlan, an old Kansas pioneer who claimed that he had learned the song from its authors in 1874.

In this example the lawsuit was brought 29 years after the publication of the Goodwins' song. Even so it took Moanfeldt months to turn up the evidence, two important parts of which were a 20-year-old newspaper clipping and a statement from an 86-year-old man. If 95-year copyright had been the law in 1905, "An Arizona Home" would be under copyright until January 1, 2000. Then, even if "Home on the Range," had achieved its popularity in the 1980s rather than the 1930s, it would still have been vulnerable

[18] see http://homepages.law.asu.edu/~dkarjala/OpposingCopyrightExtension/publicdomain/SecretGardenDWs.html

to the claims of "An Arizona Home". But by then, witnesses who could have testified to having learned the melody in the 1870s and 1880s would all have been dead. The strong evidence of 1934 would have been partly or entirely impossible to find in 1984. The plaintiffs still might not prevail, but the whole proceeding would be much more expensive, and the outcome much less certain. Regardless of the eventual outcome, merely the possibility that some obscure claim could arise from far in the past can complicate the commercial use especially of traditional music.[19][20]

These examples are great footnotes for the notion of "cost of expression" – in a broader sense that overly stringent copyright legally empowers the copyright owners who may get in the way of general access to the works of authorship, by future creators and consumers alike; or in a narrower sense that tight copyright tends to burden future creators in their ability to adopt, modify or make derivative works, hence having an impeding effect on innovations which copyright was originally set up to guard against. To highlight the importance of the "cost of expression" is not to advocate getting away with copyright protection, but to show a spectrum of copyright protection is able to lead to various impacts on subsequent creations. In this regard, the previous studies have focused on the effect of copyright on end users who consume the works alone. The "cost of expression" then points to the effect on future innovations, on which subject few studies have been carried out.

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[19] Timothy Phillips, see http://homepages.law.asu.edu/~dkarjala/OpposingCopyrightExtension/commentary/PhillipsStmt.html

[20] Patent protection as well highlights this public policy dilemma. As required by the "disclosure clause", it is obligatory that the owner of the patent has to publish the full content of the technology in exchange for a patent protection. Additionally, the utility patent (obtained for the utilitarian or functional nature of a machine, for instance) expires 20 years after the filing date of the application, while a design patent (the physical appearance of an article) is protected for 14 years. These measures were taken -- as in contrast to the authors-life-plus-70-years copyright protection -- in a way that evidently suggests the policy makers – at least in the case of patents --are fully aware and seriously concerned with the possible disruptive effects of long and extensive protection on future innovations.

Further, the copyright effect on consumption is seen almost instantly therefore a static framework seems suitable for the study, while "cost of expression" changes the outflow of contemporaneous creations which subsequently affect the next period creation and the period after next. So the strength of copyright protection today may have a "ripple effect" for the future welfare, which then calls for a use of dynamic framework.

The present essay departs from most of previous studies by incorporating the idea of "cost of expression" to distinguish copyrights from patents. Aside from it, the essay takes into account the creation-fostering effect of copyright as another pillar. It differs from Landes and Posner (1989) methodologically as it extends Landes and Posner (1989) to a dynamic examination of copyrights.

In present essay, the manner (durations, enforcement) in which copyright is implemented affects the accumulation of creations for a given society over the planning horizon, from a social planner's standpoint. Copyright protection is regarded as a choice variable for this hypothetical social planner who endeavors to maximize aggregate social welfare over time. I employ a partial equilibrium optimal control framework to derive solutions. Both the creation fostering and creation hindering effects are carefully modeled. The aim is to find characteristics of the dynamics with an interest in the impact of technological changes.

The model has three implications:

1. As the economy grows, copyright should be relaxed gradually to generate less economic incentive on the time-path converging to the steady state.

2. When technological changes -- that reduce copying cost and facilitate low-cost dissemination of copyrightable material -- shock the system, it is implied that government should increase copyright protection temporarily before relaxing to a new steady state.
3. The economies that have fewer works of authorship should tighten protection to a higher extent when experiencing the same technological changes.

The second implication reconfirms the idea in Landes and Posner (1989) that copyright should expand when technology advances. The first and the third are new to the literature.

II. Literature Review

Novos and Waldman (1984) modeled copyright as a deterrence instrument which increases the marginal cost of each illegal production. They found partial support for the claim that lack of copyright protection will decrease the welfare loss due to underproduction. It is not likely that it will increase the social welfare loss due to underutilization. Therefore, stronger protection tends to increase social welfare.

Kolbolt (1995) used reasoning similar to Novos and Waldman (1984). He modeled copyright assuming that protection has the effect of increasing the marginal costs of illegal commercial production. The departure from Novos and Waldman's study is that in Novos and Waldman, copyright affects the costs of the end users, while in Kolbolt, copyright raises the production cost of illegal copies. Under the condition of welfare maximization, Kolbolt found support for both a minimum level of protection and a reason for limiting the extent of protection.

Richard Watt (2001) recognized that the cost which the pirate faces under copyright law is stochastic. He modeled a dynamic game where a firm enters the market yet facing two choices of being a pirate or producing originals. It is shown that social welfare is maximized when the protection is neither so strict as to eliminate all piracy nor so lax that piracy is rampant.

Next, if we consider the patents and copyrights to be two polar cases in one category – the scope of copyright is narrower, covering expression only; the patent scope is broader, since it also protects the idea embodied in the technology — we may extend our survey on patent width and length to inform copyright protection.

In his seminal study of patents and technology, Nordhaus (1969) examined optimal patent lives. His analysis showed that commodities with lower elasticity of demand have higher optimal lives. Consider that copyrighted works have narrower scopes and more close substitutes, thereby higher elasticity of demand. So according to Nordhaus' theory, copyrighted materials should be protected for a shorter term than patented technology, as in stark contrast to what is in reality. Secondly, it was shown that since different industries have different technological climates, industries with more progressive inventions should have shorter lives.

Klemperer (1990) showed that if demand is relatively more elastic in reservation price than in substitution cost, society should usually be more concerned with non-consumption and so should narrow the patent scope to ensure low prices, while if the converse is true, society should generally be more concerned with substitution within the product class and hence should broaden the patent's scope.

Using similar reasoning, Gilbert and Shapiro (1990) showed that the optimal policy calls for infinitely-lived patents whenever patent breadth is increasing costly in terms of deadweight loss. Similar reasoning can be applied to copyrighted materials as they are narrowly defined. Therefore, it is implies that there could be extended lives of copyright.

Vincenzo Denicolo (1996) reexamined the optimal patent breath extending earlier literature to the case where many firms are involved in an R&D race for a patent. Disparate natures of competition can explain diverse results in the literature. In particular, the less efficient is competition in the product market, the more likely it is that broad and short patents are socially optimal. This may potentially explain the variation among copyrights and patents since patented products have broad scopes, easy to attain more monopoly power than copyrighted materials, whose scope is much narrower. Therefore the competition in patented markets is less severe compared with that of the copyright markets. According to Vincenzo Denicolo (1996), the lives of copyrights should be longer than that of the patents.

Landes and Posner (1989) recognized the "cost of expression" --- a cost entailed by a higher level of copyright protection. The model starts off by defining the equilibrium profit -- $\Pi = (p-c)[q(p)-y(p,z)]-e(z)$ for an author where p and q are the price and quantity, assuming the author takes on both writing and publishing. c is the marginal cost and y represents the amount of illegal copies. e stands for the expression cost and is a function of copyright protection z. Total differentiating it yields $p[1-F/[e^d+e^s(1-F)]]=c$. e^d and e^s are elasticity of demand and elasticity of supply for copies. F is share of copies made by the author. Comparative statics based on this equation imply the more extensive the copyright is, the higher the price will be.

Next, the economic welfare of a single creation is given --

$w = \int_{p^*}^{\infty} q(p)dp + (p^* - c)[q(p^*) - y(p^*, z)] + \int_{p^0}^{p^*} y(p,z)dp$. p^* in this case is the equilibrium price and p^0 is the minimum price at which copiers are willing to produce a copy. The first term in the equation is consumer suplus at p^*, the middle term is the author's gross profits, and the last term is the copiers' profits. Net welfare equals $w - e(z)$.

Further, the total welfare for the economy is -- $W = W[N, w, E(N,z)] = f(N)w - E(N,z)$. W is an increasing function of both N, the number of works created, and w, the consumer and producer surplus per work before deduction the cost of creating the work, and will be a decreasing function of E, the total costs of creating works (including the cost of administering and enforcing the copyright system).[21] Maximizing with respect to z yields $N_z(f_N w - E_N) = -f(N)w_z + E_z$. From here a number of implications are drawn:

1. The optimal amount of copyright protection is greater for classes of work that are more valuable socially.
2. Optimal copyright protection requires that z^* be set below the level that maximizes the number of works created. Differently stated, strengthening copyright protection beyond z^* would increase the incentive to create more works but would not be worth the costs in reduced welfare per work, the higher costs of expression, the greater administrative and enforcement costs.
3. The greater the responsiveness of N to an increase in copyright protection, the greater the optimal value of copyright protection must be to reach equilibrium.

[21] see Landes and Posner (1989), page 341

4. The optimal extent of copyright protection tends to rise with the value of a work and that the value of a work will be greater the greater the demand for the work and the lower the marginal cost of making copies. Hence, if, over time, growth in income and technological advances enlarge the size of the market for any given work, and the cost of copying declines, copyright protection should expand.
5. The less that welfare per work is affected by copyright protection, the higher will be the optimal level of that protection because of the benefits of copyright in increasing the number of works.
6. The more that the cost of expression rises as copyright protection increases, the lower will be the optimal degree of copyright protection. This suggests that, if it is feasible to differentiate in infringement proceedings between individuals who make literal copies and those who use copyrighted material to create new, albeit derivative, works, there will be broader copyright protection against the former group than against the latter.
7. The lower the cost of administering and enforcing a copyright system is and the more responsive authors are to pecuniary incentives, the greater will optimal copyright protection be.

III. The Model

As seen from the above literature review, few of the previous analyses carefully modeled copyright in a way that both emphasizes the idea of expression cost and addresses the dynamic dimension of the protection. This paper attempts to bridge this gap. Essential elements are borrowed from Landes and Posner (1989) that include among others the cost of expression – the cost imposed upon later innovations by overly stringent earlier copyright protection. A major departure from that paper is that we introduce the time dimension of the accumulation of creations, which enables us to see the dynamic pattern of the

change in stock of creations and of the optimal copyright protection. We assume a closed economy where there is no inflow or outflow of creations. New works cannot be generated without being paid.

The main structure of the model is laid out as follows:

$$
\begin{aligned}
&max \quad \int_0^{\infty} [welfare - cost)] e^{-rt} dt \\
&s.t. \quad \dot{N}(t) = az(t)^2 + cN(t) \qquad (a < 0,\ 0 < c < 1, r > c),\ z \in (-\infty, +\infty) \qquad (1) \\
&\qquad N(0) = N_0 \qquad (N_0 > 0) \\
&\qquad N(t) \geq 0 \\
&\qquad \dot{N}(t) \geq 0
\end{aligned}
$$

where the objective function consists of welfare (producer and consumer surplus) minus cost (administrative cost and expression cost). N is the stock of works that is available to the public, comprising both the copyright protected and the unprotected works. $\dot{N}$ denotes the new works generated in each period. It is an inverse U-shaped function in z -- the strength of copyright protection. The reason to specify this way is discussed in Landes and Posner (1989) that at low levels of z the revenue-enhancing effect of limiting copying by free riders should dominate, so that $dN/dz > 0$. .... So N will increase as z increases, at least up to some level, say $\bar{z}$. Beyond $\bar{z}$ we assume that increases in the cost of expression to marginal authors will dominate, so that the number of works will begin to fall. Therefore, a quadratic function is used to denote this relationship between $\dot{N}$ and z. a is a negative constant and c is a positive fraction and is assumed to be less than discounting factor r. The economy starts with N_0 innovations.

Copyright protection involves such considerations as the necessary degree of similarity between two works before infringement can be found, the elements in a work that are protected, and the period of time for which work is protected. Same as in Landes and Posner (1989), we take variable z as an index incorporating all these factors.

In practice, new artistic and literary works can so often be classified as within certain schools or their styles can be traced to be from certain traditions of artistic authorship, except for those path-breaking works. The relative abundance of the artistic reservoir a society has access to has a positive influence on its future creativeness. Therefore change in N is a function of both contemporaneous copyright protection and the existing number of works, accessible although restricted by copyright protection. The constraint can be viewed as an inverse U-shape function in copyright protection augmented by a fraction (c) of existing works.

The above function can be further specified as:

$$\max \int_0^{\infty} [\log(N(t))\, w - f\, N(t) - d\, z(t)] e^{-rt} dt$$

$$\begin{aligned} s.t. \quad & \dot{N}(t) = a z(t)^2 + c N(t) \qquad (a<0,\ 0<c<1,\ f>0,\ d>0,\ r>c),\ z \in (-\infty, +\infty) \qquad (2) \\ & N(0) = N_0 \qquad (N_0 > 0) \\ & N(t) \geq 0 \\ & \dot{N}(t) \geq 0 \end{aligned}$$

The objective function is in the similar structure as that of the Landes and Posner (1989). The first term in the bracket is the instantaneous social welfare associated with all works existing at the moment. w represents the welfare of each work consisting of consumer and producer (author and copiers) surplus[22].

[22] Here it is assumed that the welfare per work is independent of the degree of copyright protection. I also attempted to let the welfare per work be a function of copyright. However, that led to a system with two unstable equilibria, the result is reported in Appendix II. I thank Dr. Bill Ethier, Dr. Keith Maskus, Dr. Denise Konan, Dr. Edwin Lai

It is assumed that the welfare of each work is the same across different works. The marginal total welfare is *"diminishing as the number of works created increases"*[23]. A logarithm function is used to reflect this pattern. Technological change comes into play through w (technology advances will generally enlarge w as will be discussed later) and it will in turn affect the optimal level of copyright protection.

The last two terms in the bracket is the cost of administering and enforcing the copyright system which positively correlates with N and the "costs of creating works" including the expression cost represented by $dz(t)$ and. These two costs denoted by one variable in Landes and Posner (1989) are decomposed here. f and d are the partial derivatives of the social cost with respect to N and z and are assumed positive constants.[24]

The Hamiltonian is thus formulated as:

$$H = [\log(N(t))w - fN(t) - dz(t))]e^{-rt} + \lambda(az(t)^2 + cN(t)) \qquad (3)$$
$$N(0) = N_0 \qquad (N_0 > 0)$$

The objective function is clearly twice differentiable in both N and z and since it is a quadratic function in z, a corner solution is infeasible.

Convert it into a current value Hamiltonian:

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and other participants at *the Hong Kong City University International Economics III: Intellectual Property Protection and International Trade* for pointing this out and their kind assistance.

[23] Landes and Posner page 342.

[24] It might be more realistic to assume that the total cost is a product of both z and N because the marginal affect of either z or N on social cost depends on each other. For instance, the increment of total cost because of one unit of increase of z, the copyright protection, will be enlarged or reduced if N is large or small. Same can be reasoned the other way around.

$$H_c = [log(N(t))w - fN(t) - dz(t))] + m(az(t)^2 + cN(t)) \qquad (4)$$

$$where \;\; m = \lambda e^{rt}$$

$$N(0) = N_0 \qquad (N_0 > 0)$$

where z is the control variable, N is the state variable and m is the co-state variable.

The maximizing principle of optimal control yields:

$$\frac{\partial H_c}{\partial z} = -d + 2maz = 0 \qquad (5)$$

which gives rise to expressions of z and m, respectively:

$$z = \frac{d}{2ma}$$

$$m = \frac{d}{2az}$$

by maximizing principle of optimal control, we also have:

$$\dot{m} = rm - \frac{\partial H_c}{\partial N} = rm - \frac{w}{N} + f - cm$$

substituting for m gives:

$$\dot{m} = \frac{d}{2az}(r - c) - \frac{w}{N} + f$$

This expression determines the rate of depreciation of the current-value of co-state variable m. It is the sum of the rate of contribution of N to the instantaneous social welfare $(\frac{w}{N} - f)$ and that of N to the future welfare adjusted by the discount rate $\frac{d}{2az}(c - r)$.

Totally differentiating z with respect to time t and substituting for m and $\dot{m}$ provides:

$$\dot{z} = \frac{z}{-d}[\frac{(r-c)d}{2az} - (\frac{w}{N} - f)] \qquad (6)$$

Solving for the system of differential equations consisting of the dynamic constraint and equation (6), we derive a dynamic relationship between z, N, which is depicted in Figure 2.1.

As seen in the diagram $\dot{N} = 0$ is a quadratic function in N-z space. There are two equilibria as seen in the diagram, point A and E. However, only one of them E is the saddle point equilibrium, whereas A is an unstable equilibrium.

***Lemma I**: The determinant of the Jacobian matrix of the system of differential equations $\dot{N} = 0$ and $\dot{z} = 0$ is negative and the trace of it is positive when $z^* < 0$, therefore, there exists one saddle point equilibrium. The determinant of the Jacobian matrix is positive and the trace of it is positive too when $z^* > 0$, therefore there is another unstable equilibrium.*

Proof is provided in the Appendix I.

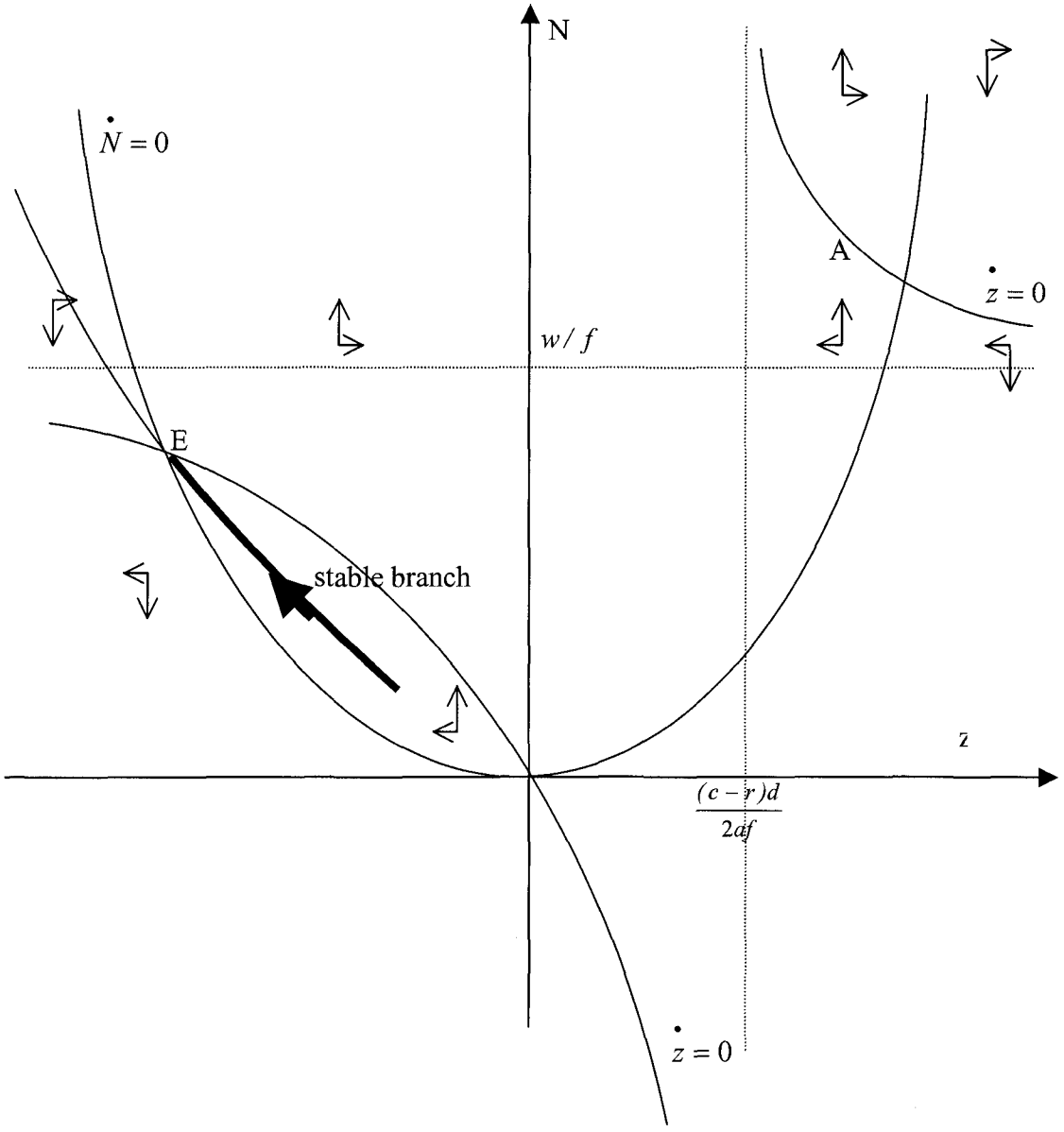

Figure 6 Equilibria and Stable Branch

The above diagram shows that in order for the economy to converge to the steady state, the amount of creations needs to grow from a low level following a path leading to a state where there is no new works being created. The upper part of the stable branch is out of our concern, because it is impossible that the number of works diminishes to the steady state level due to the constraint $\dot{N} \geq 0$, for the reason that the stock of works of authorship, unlike capital or natural resources which can be depleted over time, exist from the moment they are created. We assume that these materials are placed in the pool of works created prior to that point in time whose existence can never be denied or erased, despite that they may fade in people's memory as time passes by.

Hence, the stable branch above equilibrium E is not feasible due to the nature of works of authorship. It is implied that the rate of copyright protection z, as implied by the bold curve, leads a path of gradual relaxation to the extent that the number of works stops increasing, as is required by the definition of the steady state.

IV. Technological Change

In the present essay, we focus on the types of technological changes that will reduce the costs of copying, such as the invention of photocopiers that makes it much cheaper to reproduce books and magazines, the advent of the World Wide Web that instantly disseminates copyrightable digital material, the file-swapping peer-to-peer technologies, and the alike. We recognize that there are other technologies designed to circumscribe those activities and raise costs of reproduction as a result. The multiple access-control technologies used to detect file exchanges in 1995 is an example. Nonetheless, the inventions of cassette recorder, video recorder, CD-ROM among others and their successful commercialization despite legal and technological efforts of impediment show that the forces of cost-reduction was predominant in the past and will likely to prevail in foreseeable future.

It is clear in Landes and Posner (1989) that the primary effect of cost-reducing technologies in the context of copyright protection is that they generally enlarge welfare per work. In that paper, w, the welfare per work takes on the form of:

$$w = \int_{p^*}^{\infty} q(p)dp + (p^* - c)[q(p^*) - y(p^*, z)] + \int_{p_0}^{p^*} y(p, z)dp$$

The first term in the equation is consumer surplus at p^* (the profit-maximizing price set by the author), the middle term is the author's gross profits, and the last term is the copiers' profits.[25][26]

[25] Landes and Posner (1989)

[26] there seem to be two shortcomings in the specification of w in Landes and Posner (1989). One is that there is no differentiation between the welfare per work under or not under copyright protection. I deem this differentiation important since the two cases are distinct from each other apparently. For instance, there is no copiers' surplus if there is no protection as copies will be sold at their marginal costs. An important distinction is blurred when tackling this problem without paying attention to this.

As discussed therein: "...and w will be greater the greater the demand for the work and the lower the marginal cost of making copies. ... over time, growth in income and technological advances enlarge the size of the market for any given work, and the cost of copying declines..."

It is indicated in their paper that the author sets the price which will be followed by fringe producers. A typical dominant fringe competitive model also confirms that the "welfare per work" rises as copying cost (or marginal cost) decreases.

Secondly, the specification for the copiers' surplus is debatable, which is the last term in the above expression of w. The market structure Landes and Posner had assumed is implied in the second term in the equation -- $(p^* - c)[q(p^*) - y(p^*, z)]$, where p^* is the market price, c is the marginal cost or cost of copying. $q(p^*)$ is the market demand at the equilibrium price. $y(p^*, z)$ is the total supply of the fringe copiers at p^*. It is indicated that at each moment in time there would be only one price viable. All copiers are following this price which is likely to be set by the original author (no publishers and such are considered). However, it contradicts the last term where there is a copiers' supply curve. It seems that the copiers are distributed along the supply curve with p from p_0 to p^* and they are facing a schedule of price where each of them are somehow ranked in certain ways. It is indisputable that there is a minimum price p_0 only above which copiers begin to produce. However, under the assumption that there is little difference across the copiers which Landes and Posner do seem to agree with, there is no rationale to argue that each copier faces different price so as to have their total surplus equal $\int_{p_0}^{p^*} y(p, z)dp$.

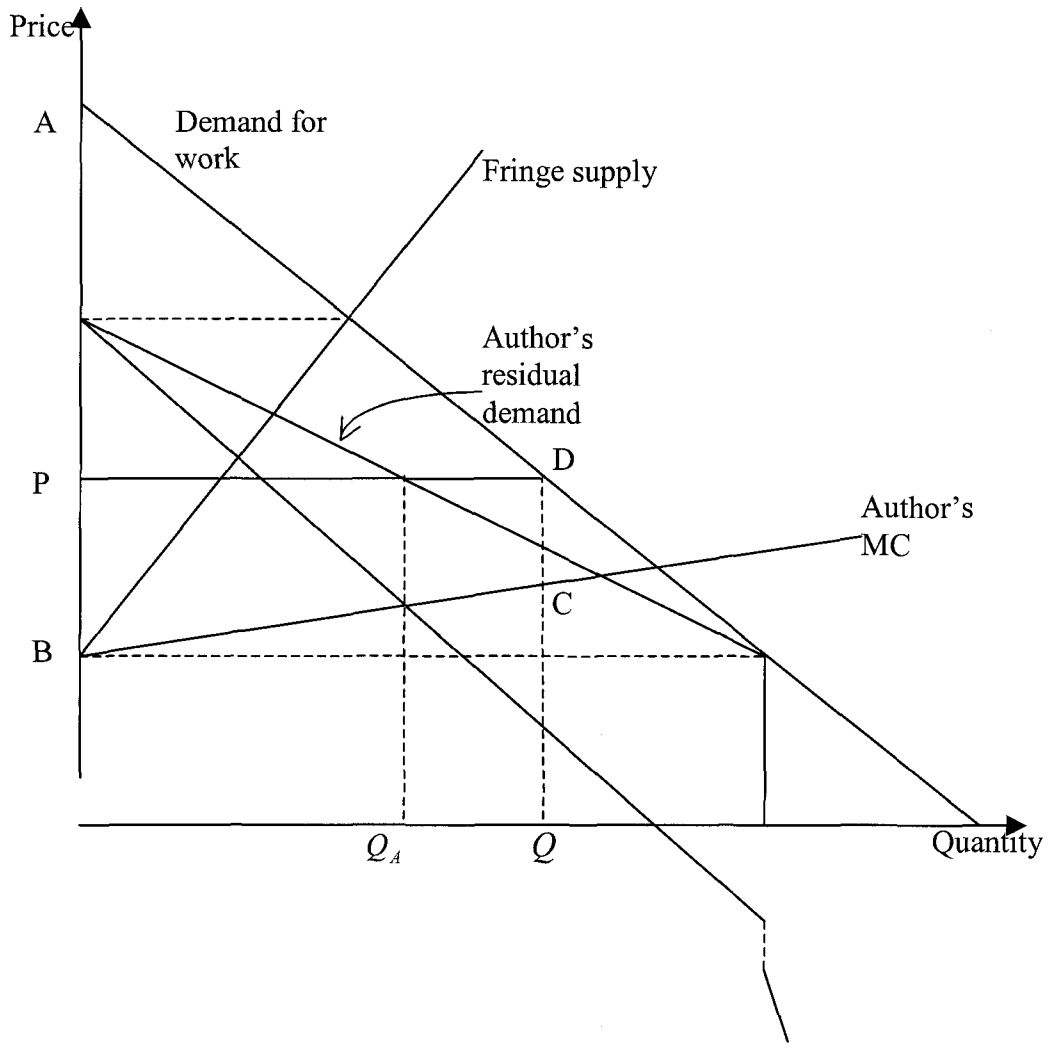

Figure 7 Change in Welfare per Work

As illustrated by Figure 2.2, the author faces residual demand, namely, the difference between the total demand and fringe supply. The residual demand governs the marginal revenue which together with marginal cost of the author determines the optimal quantity and price. The fringe suppliers or pirates take price as given and optimize the production. It is straightforward to see that a decrease in marginal cost will encourage fringe supply, reduce price, total amount produced will increase. As a result, the "welfare per work" -- the sum of consumer surplus and producer surplus, will unambiguously rise.

Returning to equation (6), an increase in welfare per work will break the balance at the equilibrium. The terms in bracket, specifically, $\frac{(r-c)d}{2az}-(\frac{w}{N}-f)$ are derived from the objective function and represent the rate of contribution of N to the instantaneous *net* social welfare --$(\frac{w}{N}-f)$, and that of N to the future welfare --$\frac{(c-r)d}{2az}$. It is implied in equation (6) that the difference of the two terms is equal to zero at steady state. As w increases, the innovative works contribution to the instantaneous net social welfare becomes greater than that of the future social welfare, which implies the *status quo* is off steady state. Diagrammatically, the change augments curve $\dot{z}=0$. Since $\dot{N}=0$ is unaffected, the resulting equilibrium N^* will be higher than in the previous equilibrium, whereas z^* will be lower.

In this event, both of the control and state variable are to be adjusted to adapt to the new equilibrium. In particular, z is to be decreased and N to be increased, *eventually*, as implied by equation (6).

However, the intermediate movement is governed by the new equilibrium and its stable branch. This would generate an interesting pattern that copyright protection z will be strengthened initially, as illustrated in Figure 2.3, jumping onto the stable branch (point A), then decrease gradually, passing beyond the extent of previous protection. N will increase and converge to the new steady state E'.

The force that drives z to have a phase of increase is that new steady state requires higher amount of works of authorship, while z is at the leftmost threshold not being able to generate positive $\dot{N}$ (recall that $\dot{N}$ is an inverse U-shaped function of z). Therefore for N to increase before new steady state is

reached, z would have to increase to generate greater incentive to raise N to the new equilibrium level. After initial increase, z will be loosened to converge to the new steady state.

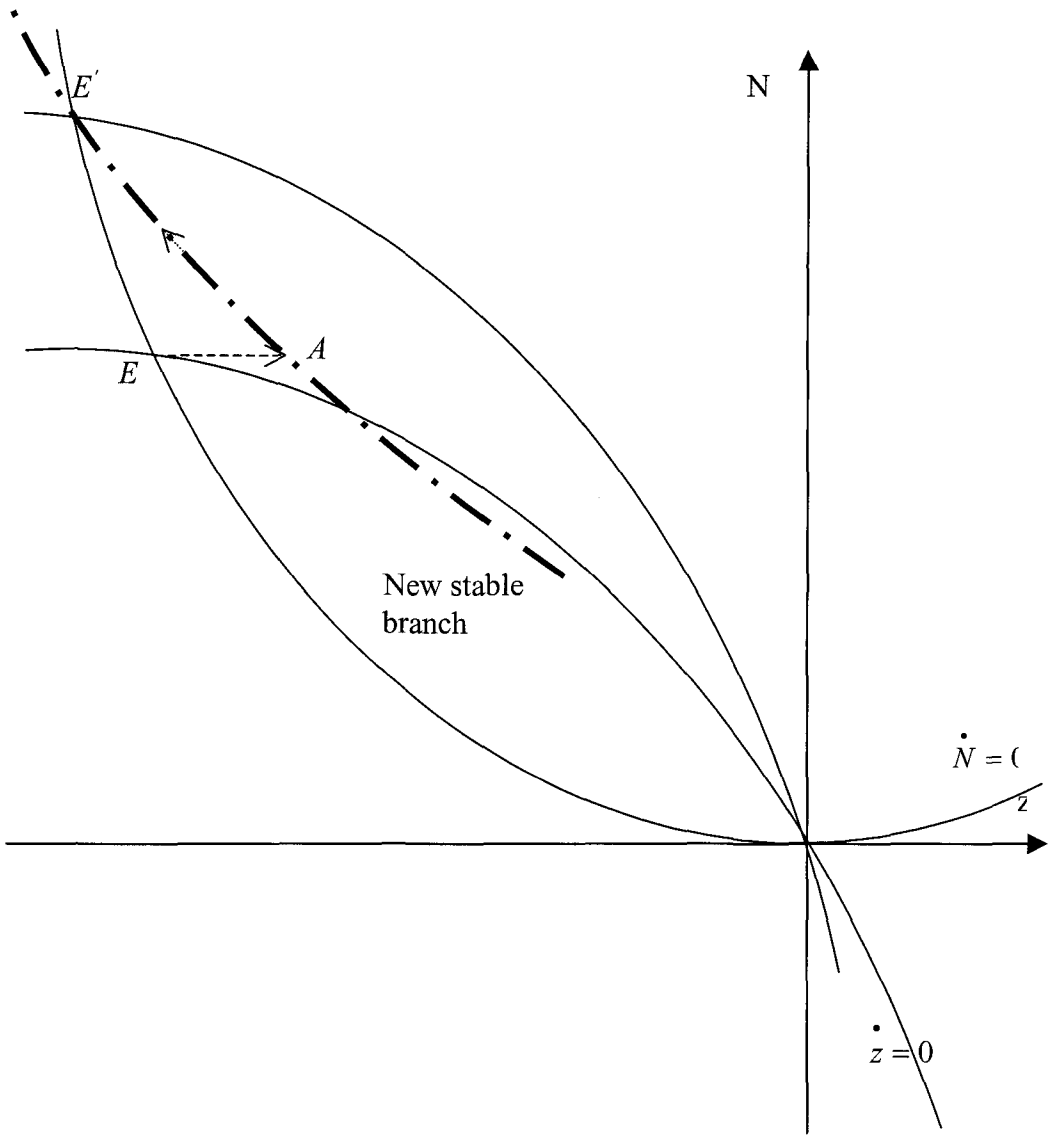

Figure 8 Technological Shock

We have focused on one-time technological change in the above discussion. In the scenario of multiple or continuous technological changes, the model implies successive strengthening of copyright protection is needed to maximize social welfare objective.

As illustrated in Figure 2.4, if multiple technological changes occur, the curve $\dot{z} = 0$ is to be augmented each time, resulting in increasingly higher equilibrium N and lower equilibrium z. Successive jumps are also expected from previous stable branch to newer ones. Depending on how temporally close each technological change occurs, we may observe different patterns of path to converge to new equilibrium. For instance, if changes occur discretely and sufficiently "distant" from each other, we may be able to find zigzags in the equilibrium path. In the case shown in Figure 2.4, technological shock shifts the equilibrium from E to E', there we find copyright protection tightened while there is no change in number of works of authorship at this instant (point A). Tightened copyright protection generates incentive for the authors, N begins to move up and z gets gradually loosened on the path converging to E'. However, if another wave of technological shock takes place that pushes down copying cost, we would expect equilibrium is further up to E'', which implies the status quo is off the stable branch again and needs to re-adapt itself onto the new stable branch associated with E''. Hence, copyright is further tightened to accommodate the change by moving from B to C. It converges to final new equilibrium E'' afterwards.

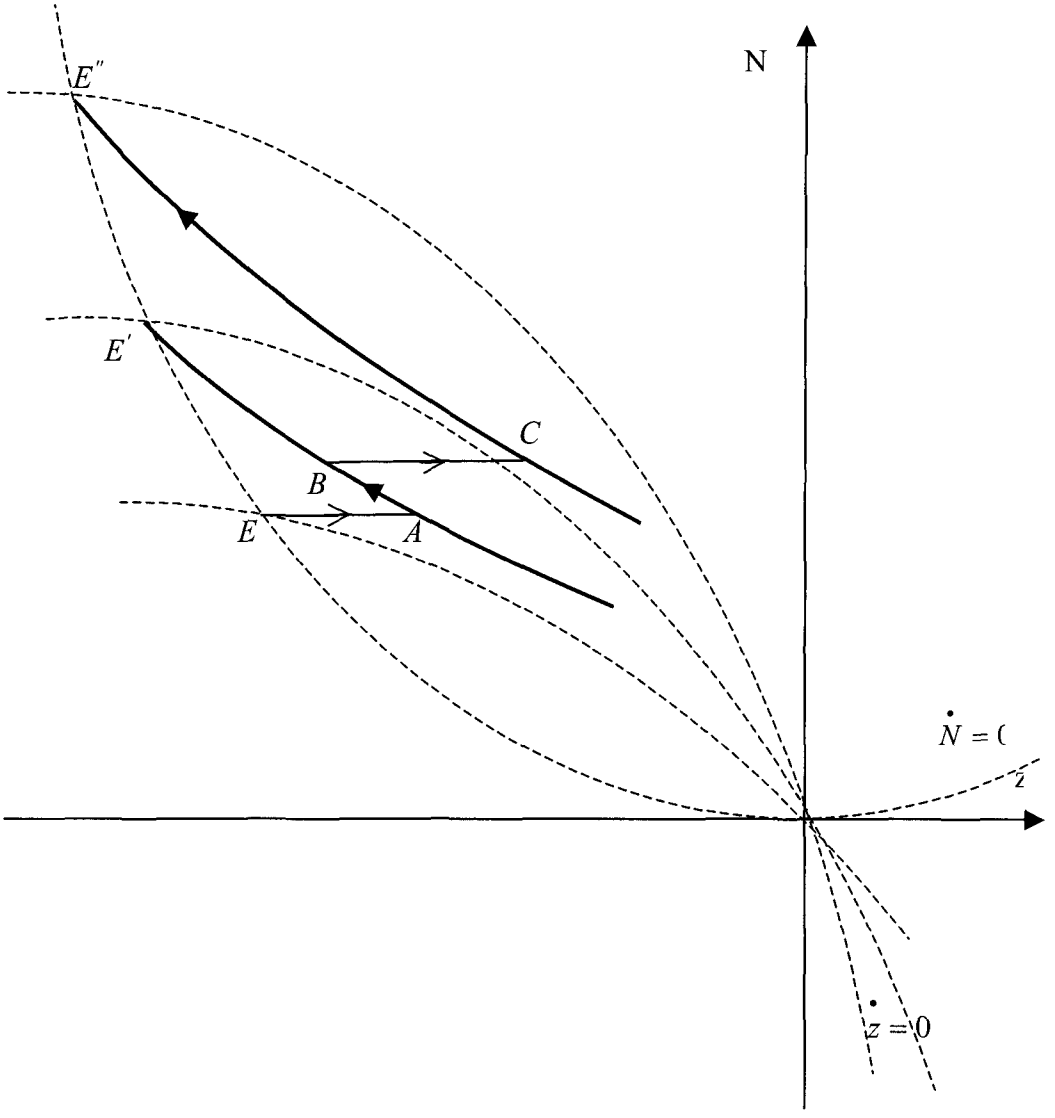

Figure 9 Continuous Technological Shock

In addition, it is anticipated that if cost-reducing technological changes occur so frequently as to be regarded as almost continuous, such intervals as from A to B in Figure 2.4 will vanish in the limit. The above zigzag patterns should be rather smooth as it may seem to be an incessant strengthening of copyright protection up to the point when technological changes no longer happens.

Despite restrictive assumption that prevent this model to simulate the real world, it does appear to correspond well to what had happened to the US copyright law, from the end of the 18th century when the term of protection was 14 year plus another renewable 14 years if the authors is still alive, to the end of the 20th century, after series of extensions, of authors life plus 70 years. This period of time is apparently characterized by substantial technological advancement that made it increasingly easier to disseminate musical works, visual arts, books, or mere information.

It is also noteworthy that there is an upper limit to which $\dot{z} = 0$ converges to, namely, w/f in Figure 2.1. The maximum of the "welfare per work" is the entire triangle under the demand curve in Figure 2.2, which can be denoted as w^{max}/f, somewhere above w/f. It corresponds to the extreme case where the cost of copying decreases to zero. Therefore the model implies that the copyright protection will reach a finite upper bound as the technological changes bring the copying cost down to near zero.

Lemma 2:

Copyright protection z in a given economy ranges from $\lfloor z^*, z^{max} \rfloor$, where both z^* and z^{max} are constrained by parameter values. z^{max} is further determined by status quo number of works of authorship, $N(0)$. In particular, the lower $N(0)$ is, the higher z^{max} is.

See proof and the computation of z^{max} in Appendix II.

Therefore, it is implied that for economies with lower $N(0)$ to begin with, more strongly enforced copyright protection may be necessary to restore equilibrium. As is also shown in Figure 2.4, facing same new equilibrium E'', thus the same new stable branch, economies with lower initial $N(0)$ need to go a longer distance to jump onto the new stable branch to eventually converge to E''. Intuitively, for economies with lower $N(0)$, the difference between $N(0)$ and equilibrium N is greater, therefore stronger copyright protection may be needed to generate comparatively more incentive to sustain a longer converging path.

It is worth noting that according to the definition of steady state in present model, most economies can not be plausibly classified as on steady state now, since it is clear that at steady state, there is no further increasing in the number of works. Unrealistic it may seem, it depicts a situation where an extra unit of N does not generate an increase in net welfare. In other words, the current value Hamiltonian equation (4) implies that at steady state a possible increment in welfare $log(N)w$ will be offset by additional administrative cost fN. No matter how small in value fN might be, as increment in welfare $log(N)w$ is a concave function and so long as f is positive finite, there will be a point in time that $\frac{\partial(log(N)w)}{\partial N} = \frac{\partial(fN)}{\partial N}$ when N stops increasing. Apparently, additional benefit is traded off against additional cost. In fact, social cost can be rather significant if copyright is strongly enforced and

extensively long.[27] In this case, if authors are rational economic agents, as commonly assumed, and if this externality is internalized through tax or other means, it is not difficult to predict a point in time when all creative activities exist no more[28]. It could also be the hypothetical case that the society is affluent with creative works to the extent that one can hardly come up with anything new. Taking these extreme scenarios as benchmarks, there is almost no country in the world that is currently at steady state. Therefore, according to this model, most economies may be on the path of converging to their respective steady states.

V. Conclusion

In the present essay, the copyright is modeled as an independent category in the intellectual property rights family. The "cost of expression" is the idea that separates copyright from patents and other components of intellectual property rights. Previous studies on copyright were not generally successful in distinguishing copyrights from patents as they stress the increased cost on illegal copiers and consumers of copyright protection. Landes and Posner (1989) is extended into a dynamic study in this essay that generates some new insights.

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[27] Therefore, the total instantaneous cost can also be modeled as fzN. So $\frac{\partial fzN}{\partial N} = fz$, implying that the marginal effect of N on the total cost is a function of z, copyright protection.

[28] Or one may formulate an alternative model (as in standard growth model) where per capita terms remain constant at steady states, while the economy grows at the same rate as the population grows.

Landes and Posner (1989) does not explicitly discuss the change in copyright over time, and no time dimension is incorporated in their model. Therefore, we would assume they propose no change in copyright protection *ceteris parabus*. In addition, they concluded that copyright should expand in the face of technological advances that reduce copying cost.

In contrast, the present model implies that:

1. As the economy grows, copyright should be relaxed gradually on the time-path converging to the steady state.
2. When technological changes shock the system, it is implied that government should increase copyright protection temporarily before relaxing to a new steady state.
3. The economies that have fewer works of authorship should tighten protection to a higher extent when experiencing the same technological changes.

Except the second implication that partially reaffirms the idea in Landes and Posner (1989). The first and the third are new to the literature.

I presented an optimal control model of copyright protection, emphasizing the importance of "expression cost" together with copyright's role in fostering creations. The model produces implications that resemble the real world to some extent. For example, copyright needs to be continually expanded in the face of technological changes that reduce copying cost and make it easier to disseminate copyrightable materials, as apparent in US copyright legislation history in the past century. In addition, it generates predictions of how copyright protection should be adjusted when technological changes cease to occur.

The model implies that copyright protection should be gradually relaxed to let number of works of authorship increase at a decreasing rate while converging to the steady state.

The strongest assumption in the present essay is that authors derive their incentive to create exclusively from the appropriability of the profits, for convenience of modeling. We should note that people create out of a whole variety of motivations, some for monetary rewards, others for academic prestige, a competitive edge, some even create totally out of their own curiosity and interest. However, it will be an entirely different paper discussing how sensitive the innovations are with respect to copyright protection. Yet there is no doubt that modern intellectual property right system or copyright in particular has played a critical role in encouraging or (discouraging as some argue) human creativity by manipulating monetary incentives.

As is evident in the model, we assume copyright is entirely at disposal to the social planner as it can be readjusted any time to maximize welfare at his/her will. This concept is for the most part drastically different from how copyright is actualized in the real world. The political economy and struggle of vested interests are completely void in our discussion. The model implies copyright protection should continuously be relaxed if without technological change, which is in stark contrast to the statutes that tend to fix the term constant for certain period of time.

The two pillars of the model are creation-hindering (cost of expression) effect and creation-promoting effect of the copyright protection. To highlight cost of expression and to make the model mathematically tractable, I omitted the role of copyright in leveraging consumption – ample evidence suggests that the grant of monopoly power as copyright does tends to reduce consumer welfare due to higher price and less availability. This constitutes another drawback of the present model.

As the first attempt to bring optimal control and dynamic analysis to the field of copyright economics, the model is simple in structure and provides much room for further research. First of all, w in the present model can be further differentiated, such as the "welfare" for works under copyright protection and for works not under protection. It is also possible to specify a distribution of the "welfare" in the entire economy, which, however, may introduce stochastic elements in solving the Hamiltonian. Secondly, w can be assumed to decrease with the copyright expansion to reflect the aforementioned consumption leveraging effect. Thirdly, the nature of the problem – that most countries are off steady state – dictates that it will be more desirable to solve the model without linearing it. However, constrained by mathematical tools currently available, an analytical solution is difficult to derive and it is quickly obvious that analytical solutions do not exist when the model becomes complicated. Numerical solutions provide another direction of trial; however, it is largely impractical if an abstract economic value cannot be quantitatively gauged, such as the extent of copyright protection in present exploration. Further, it is almost infeasible too if the solution is a saddle point equilibrium which means in solution space, only one out of virtually infinite number of possible paths is the one that converges.

Appendix I

Movie, The Secret Garden (1993), Warner Bros.

Musical, The Secret Garden (1991), music by Lucy Simon, book & lyrics by Marsha Norman

Cabaret adaptation, The Secret Garden, Studio 54 (New York)\

Made-for-TV adaptation, The Secret Garden (1987), starring Gennie James and Derek Jacobi

Cookbook, The Secret Garden Cookbook : Recipes Inspired by Frances Hodgson Burnett's the Secret Garden (1999), by Amy Cotler and others

Searchable Online Version, The Secret Garden

CD-ROM Version, The Secret Garden on CD-ROM, Antelope Publishing

Musical Adaptation, The Secret Garden (1999), by Frumi Cohen

Annotated with hyperlinks, The Secret Garden (annotations advancing emotional literacy education)

Audiobook, The Secret Garden, read by Johanna Ward

Radio Theater, The Secret Garden

Stage Production, The Secret Garden, adapted by Sylvia Ashby, directed by Eric Gomes, produced by Suzanne Avtges

BBC Playhouse Video, The Secret Garden (1988)

Reading Guide, Family Reading Guide to The Secret Garden (sample chapter)

Appendix II

In Appendix II, I explore the possibility of modeling the copyright by letting the welfare per work w be a function of copyright. In principle, the welfare per work should have both an upper and lower bound, and be negatively correlated with copyright. Ideally, a transformed arc-tangent function should be used to model this type of relationship. However, given the complexity of arc-tangent function and its derivatives, it is almost certain the model will quickly become intractable. Therefore, I use a negatively sloped linear function to proxy this relationship. The modified model is as follows:

$$max \quad \int_0^\infty [N(t)(hz+g)/T - f\,N(t) - d\,z(t)]e^{-rt}dt$$

$$\begin{aligned} s.t. \quad & \dot{N}(t) = a\,z(t)^2 + c\,N(t) \qquad (a<0,\ 0<c<1, f>0, g>0, h<0,\ d>0,\ r>c),\ z\in(-\infty,+\infty) \\ & N(0) = N_0 \qquad (N_0>0) \\ & N(t) \geq 0 \\ & \dot{N}(t) \geq 0 \end{aligned}$$

The only major difference from the original model is that welfare per work is expanded to $(hz+g)/T$ where $h<0$ and $g>0$, T is the cost of copying due to technological changes. As copyright tightens, the welfare per work decreases since the deadweight loss increases due to higher prices.

The above optimal control problem boils down to a system of differential equations as follows:

$$\dot{z} = \frac{1}{dT - Nh}(ahz^3 + 2az^2(g - Tf) - cNhz) - z(r-c)$$

$$\dot{N} = az^2 + cN$$

which generates the following diagram characterizing the equilibria:

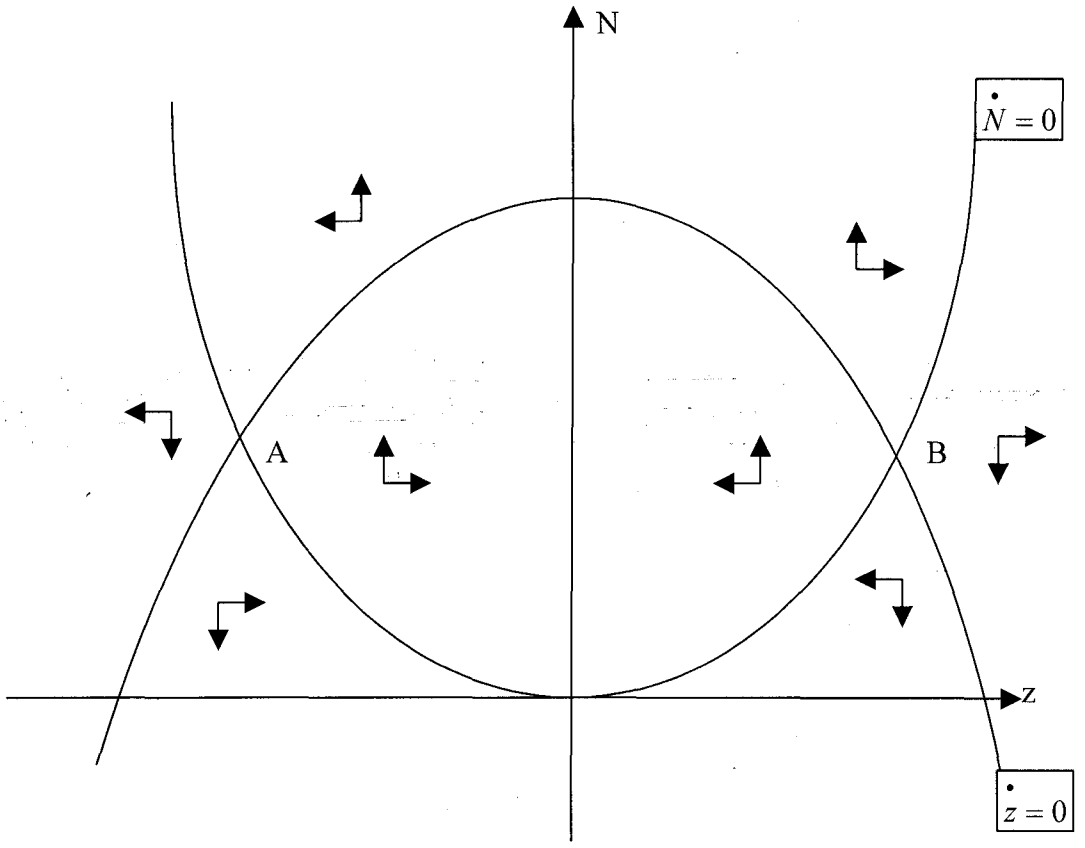

Figure 10 Equilibria When Welfare Per Work Responsive to Copyright

Figure 2-5 illustrates that both equilibria A and B are unstable. Therefore, no meaningful implication can be drawn from this exercise.

Appendix III

The system of differential equations

$$\begin{cases} \dot{z} = \dfrac{z}{-d}[\dfrac{(r-c)d}{2az} - (\dfrac{w}{N} - f)] \\ \dot{N} = az(t)^2 + cN(t) \end{cases} \qquad (A.1)$$

is linearized around steady state z^* and N^*, the steady state rate of copyright protection and number of creations. The coefficients in the Jacobian matrix are obtained as below:

$$\frac{\partial \dot{z}}{\partial z}\Big|_{z^*,N^*} = r - c > 0$$

$$\frac{\partial \dot{z}}{\partial N}\Big|_{z^*,N^*} = \frac{2az^{*2}w}{-dN^{*2}} > 0$$

$$\frac{\partial \dot{N}}{\partial z}\Big|_{z^*,N^*} = 2az^*$$

$$\frac{\partial \dot{N}}{\partial N}\Big|_{z^*,N^*} = c > 0$$

We have assumed that $r - c > 0$. r is the discounting factor that normally ranges from .05 to .1, while c denotes the derivative of new creations with respect to extant creations at particular point of time. Facing a vastly large number of works of authorship in the long history of mankind, new innovations at each point in time represent presumably a much smaller a fraction than the discounting factor. This is more true when the economy approaches the steady state when innovations have slowed down while previous stock of works is a respectable accumulation.

The trace of the Jacobian matrix is the sum of $\frac{\partial \dot{z}}{\partial z}\Big|_{z^*,N^*}$ and $\frac{\partial \dot{N}}{\partial N}\Big|_{z^*,N^*}$, i.e. r>0. The determinant of the matrix is calculated as follows:

$$\begin{aligned} det &= (r-c)c + 2az \cdot \frac{z}{Nd}[(r-c)d + 2azf] \\ &= (r-c)c + 2az^2(r-c)/N + (2az)^2 fz/dN \qquad (A.2) \end{aligned}$$

The first term of (A.2) is positive, second term negative because $a < 0$, the third term has the same sign as z^*.

Let's first proceed with the case of negative z^*. Since the third term is negative, the determinant is negative if the sum of the first two terms is negative. Therefore, suppose,

$$(r-c)c+2az^2(r-c)/N<0$$
$$then\ \ (r-c)(2az^2/N+c)<0$$

then if $(2az^2/N+c)<0$ $\qquad (A.3)$

the determinant will be negative. Since at steady state, $az^2+cN=0$, which means $-c=az^2/N$. Substitute this expression into (A.3), we arrive at

$$2az^2/N<-c$$
$$2az^2/N<az^2/N$$

because $a<0$, then

$$2>1$$

Therefore, the determinant is negative when $z^*<0$. Since the determinant is the product of the two characteristic roots, there must be both a positive and a negative characteristic root associated with this steady state, implying it is a saddle-point equilibrium.

In contrast, when $z^*>0$, the third term in (A.2) is positive and the sum of the first two terms is positive as well. Thus, the determinant is positive. Because the sum of the characteristic roots is the trace of the Jacobian matrix, there are two positive roots associated with this equilibrium, implying it is unstable.

Appendix IV

Setting the left hand side of the differential system (A.1) to zero, we obtain equilibrium z^* and N^*:

$$\begin{cases} z^* = \dfrac{d(c-r)+\sqrt{d^2(c-r)^2-16acfw}}{4af} \\ N^* = -\dfrac{[d^2(c-r)^2-8acfw+\sqrt{d^2(c-r)^2[d^2(c-r)^2-16acfw]}]}{8acf^2} \end{cases}$$

$$\begin{cases} z^* = \dfrac{d(c-r)-\sqrt{d^2(c-r)^2-16acfw}}{4af} \\ N^* = \dfrac{[-d^2(c-r)^2+8acfw+\sqrt{d^2(c-r)^2[d^2(c-r)^2-16acfw]}]}{8acf^2} \end{cases} \qquad (A.4)$$

The second set of solution is the saddle-point stable equilibrium on which we will focus our attention as it contains a negative z^*. The first set represents the unstable equilibrium as it contains a positive z^*. We will refer to the second solution from now on.

Since the trace of the Jacobian matrix is r and the determinant is given by (A.2), we are able to derive two characteristic roots λ_1 and λ_2 using the fact that $\lambda_1 + \lambda_2 = trace$ and $\lambda_1 \cdot \lambda_2 = determinant$. We have

$\lambda = \frac{1}{2}(-r \pm \sqrt{r^2 - 4c(r-c) - \frac{4z^* w(2az^*)^2}{dN^{*2}}})$, with $\lambda_1 > 0$, $\lambda_2 < 0$ containing the positive and negative sign before the square root.

In determining the dynamic solution, we need to choose a zero value for the free coefficient that multiplies the solution part associated with the positive root. We also have to choose the remaining free

coefficient so as to ensure that at time zero z and N match certain initial values. This procedure leads to the solution

$$z(t) = z^* + (z(0) - z^*)e^{\lambda_2 t}$$
$$N(t) = N^* + (z(0) - z^*)\Lambda e^{\lambda_2 t} \qquad (A.5)$$

where $[1, \Lambda]^T$ is the eigenvector associated with λ_2. Λ is negative because elements of the Jacobian matrix are all positive and $\lambda_2 < 0$.

Suppose the system experiences a shock at the moment when $N(t) = N(0)$ Thus, from the second equation of (A.5), we have

$$z(0) = \frac{N(0) - N^*}{\Lambda e^{\lambda_2 t}} + z^* \qquad (A.6)$$

Since $N(0)$ is always less than N^* and Λ is negative, the first term of (A.6) is positive and the second is negative. Therefore $z(0)$ can be either positive or negative. More importantly, as N^* increases, $z(0)$ increases. The lower $N(0)$ is, the higher $z(0)$ is. Therefore, it is implied that for economies with lower $N(0)$ to begin with, more strongly enforced copyright protection may be necessary to restore equilibrium.

If we regard $z(0)$ as a result of a policy change after an exogenous shock that reduces copying cost to zero and maximizes "welfare per work", w, -- taken as an extreme instance, we have according to (A.4) N^{***} and z^{***}, so to denote the equilibrium N and z associated with highest value of w. Thus, the highest possible value of z may take the form of

$$z^{max} = \frac{N(0) - N^{***}}{\Lambda e^{\lambda_2 t}} + z^{***} \qquad (A.7)$$

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CHAPTER III:

An Analysis of the Sonny Bono Copyright Term Extension Act

Abstract

The passage of Sonny Bono Copyright Term Extension Act (CTEA) of 1998 extended copyright protection by twenty years. The extension caused much debate in the U.S. Congress and among lawyers, economists, authors, composers, librarians, businessmen and copyright users both before and after its enactment into law. In this chapter, in addition to presenting the legal battle, history and term structure of CTEA and the U.S. copyright law, I closely examine various arguments put forth by proponents of the term extension. Particular emphasis is provided to arguments concerning longer life spans of authors, the well-being of authors' progeny, harmonization with European Union copyright law, the balance of trade, and technological advancement. Retroactive application of the CTEA–as a convention of copyright extension–was also analyzed. I suggest that arguments relating to transaction costs, deadweight losses, and lobbying costs, loss of future works, and productivity gains are directly relevant to the analysis of CTEA's welfare impact. I conclude by projecting that another copyright battle will be fought in the next decade and that global harmonization of copyright terms in the near future is unlikely.

I. Introduction

The U.S. Congress passed the Sonny Bono Copyright Term Extension Act (CTEA) in 1998.[29] Its main provision extended the duration of copyright protection from 'life of the author plus fifty years' to 'life of the author plus seventy years.' It also extended the term of protection for works-for-hire from 75 years to 95 years. The CTEA exemplifies the trend of strengthening intellectual property right protection over the past two centuries, which goes hand in hand with economic growth and technological change. The Act's passage provoked extensive debate among academics, businesspeople, lawyers, and end users of copyright works over its implications for particular groups and for social welfare. The legislation prompted several parties to bring suit in federal court questioning the constitutionality of CTEA. A decision of the U.S. Supreme Court, *Eldred v. Ashcroft*, upheld the statute.[30]

This chapter begins with a general discussion of CTEA, the history of copyright term extension in the United States and copyright term structure. It also reviews and analyzes the key arguments put forward by the proponents and opponents of CTEA. It touches on a wide variety of issues that bear upon term extension, including demographics, international trade, technological change and retroactivity. I also put forward a framework for analyzing the costs and benefits of copyright term extensions. Finally, I examine the prospects of further term extensions in the United States and globally harmonized copyright terms.

II. A Discussion of CTEA and a Brief History of Copyright Term Extensions

[29] See Pub L. No. 105-298 § 102(b)(1), 112 Stat. 2827; 17 U.S.C.
[30] See 537. U.S. (2003).

The Sonny Bono Copyright Term Extension Act (CTEA) amends various provisions of the Copyright Act of 1976.[31] It consists of two parts. The first section provides copyright term extensions, and the second section delineates a music licensing exemption for food service and drinking establishments. My analysis is restricted to CTEA's first section.

CTEA provides term extensions retroactively to existing copyright holders and prospectively to future copyright holders. For instance, for a work created in 1978 or later, to which an individual author holds the copyright, CTEA extends the term from 'life of the author plus 50 years' to 'life of the author plus 70 years.'[32] For a work created in 1978 or later that is anonymous, or pseudonymous, or is made for hire, the term is extended from 75 to 95 years from the year of publication or from 100 to 120 years from the year of creation.[33] For a work created before 1978, for which the initial term of copyright was 28 years, the renewal term is extended from 47 to 67 years, thereby creating a combined term of 95 years.[34] Readers may refer to Table 1 for more detailed information on how CTEA's term extensions affected the terms of twenty different categories of copyrights.

Copyright extensions have a long history. Legislatures have regularly extended copyright terms since the inception of copyright. Copyright law originated in Italy in the fifteenth century, but U.S. copyright law is solidly based on the copyright law that emerged in England during the eighteenth century in response to a demand for increased protection from the domestic publishing industry. The Statute of Anne in 1710 stipulated an initial fourteen-year term of protection, plus another renewable fourteen years if the author was alive at the expiration of the first fourteen years.[35] In 1790, the first American copyright law was

[31] 17 U.S.C. § 101 *et seq.*
[32] See Pub L. No. 105-298 § 102(b)(1), 112 Stat. 2827; 17 U.S.C. § 302(a).
[33] See Pub. L. No. 105-298 § 102(b)(3), 112 Stat. 2827; 17 U.S.C. § 302(c).
[34] See Pub. L. No. 105-298 § 102(d), 112 Stat. 2827; 17 U.S.C. § 304.
[35] See 8 Anne, ch. 19 (1710) (England).

established with identical term provisions.[36] In 1831 the U.S. Congress doubled the duration of the first term to 28 years. In 1909, it doubled the duration of the second term to 28 years.[37] Between 1962 and 1974 the Congress incrementally extended existing copyrights.[38] In 1976 the Congress altered the structure of copyright terms to ensure conformity with the Berne Convention—which the United States had just joined—and general international practice. Copyright terms typically were specified as 'life of the author plus 50 years' or 75 years for works-for-hire.[39]

In 1993, the Council of the European Union issued a Directive that extended terms on two types of copyrights by twenty years.[40] The EU's Directive specified that intellectual property of nationals from non-EU countries with shorter terms of protection would not receive the longer term in the European Union. This policy prompted various corporations and intellectual property associations to complain to the U.S. government and to press for longer copyright terms in the United States.

The first version of the copyright extension legislation was introduced in the House of Representatives on February 16 of 1995 by Representative Carlos Moorhead (R-CA) with nine other co-sponsors, including Representative Sonny Bono (R-CA).[41] A hearing was held by the House Subcommittee on Courts and Intellectual Property in June 1995. These hearings appear to have never been published. While the hearings were declared concluded on July 13, 1995 and the last cosponsor was added in March 1996, the bill was never released from the Committee for a House vote.[42]

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[36] See Act of May 31, 1790 § 1, 1 Stat. 124, 124.
[37] See Act of Feb. 3, 1831 § 1, 4 Stat. 436, 436 and Act of March 4, 1909 § 23, 35 Stat. 1075, 1080.
[38] See Pub. L. No. 87-668, 76 Stat. 555 (1962); Pub. L. No. 89-142, 79 Stat. 581 (1965); Pub. L. No. 90-141, 81 Stat. 464 (1967); Pub. L. No. 90-416, 82 Stat. 397 (1968); Pub. L. No. 91-147, 83 Stat. 360 (1969); Pub. L. No. 91-555, 84 Stat. 1441 (1970); Pub. L. No. 92-170, 85 Stat. 490 (1971); Pub. L. No. 92-566, 86 Stat. 1181 (1972); Pub. L. No. 93-573, title I, § 104, 88 Stat. 1873 (1974).
[39] See Pub. L. No. 94-553 §§ 302-05, 90 Stat. 2541, 2572-76 (1976).
[40] Council Directive 93/98, art. 7, 1993 O.J. (L 290) 9.
[41] *Congressional Record Daily Report*, 141 Cong Rec. D 849, Vol. 141 No. 113, Thursday, July 13, 1995.
[42] *Ibid.*

Similar legislation was introduced in the Senate as S.483 by Orrin Hatch (R-UT), with Diane Feinstein (D-CA) and Fred Thompson (R-TN) as co-sponsors, on March 2, 1995. It was referred to the Senate Judiciary Committee (which Hatch chaired), which conducted hearings on Sept. 20, 1995.

Senator Hatch opened the hearings with an appeal to "preserve our own culture" and proceeded to assert that copyright should be "passed on to their children and through them to the succeeding generation".

Marybeth Peters, the U.S. Register of Copyrights, was the first to offer the Copyright Office's support of the bill. She noted that the term of 'life-plus-seventy' was emerging as the international norm and presented the committee with the results of a study of copyright duration initiated by the Copyright Office in 1993.[43] Next came Bruce Lehman, Assistant Secretary of Commerce and Commissioner of Patents and Trademarks, who provided support for S.483 by testifying that "[o]nce a work falls into the public domain there is no guarantee that the work will be more widely available or cheaper."[44]

Jack Valenti, the longtime president of the Motion Picture Association of America, emphasized that Hollywood's exports played a pivotal role in America's balance of trade and that for the American copyright term to be 20 years shorter than the European term would put the U.S. film industry "at a distinct disadvantage. Revenues that would come back to the American copyright owner now are truncated and are diverted into European and other hands."[45]

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[43] *Ibid.*
[44] *Ibid.*
[45] *Ibid.*

Songwriter Alan Menken, a Grammy Award winner, testified—as did Senator Hatch—that the intent of American copyright law was to ensure protection for two generations beyond the creator of the work. He cited increasing life spans as a reason for extending copyright terms.

Professor Peter Jaszi, a law professor at American University, criticized the copyright term extension, arguing that "unlike the countries of the European Union, we have not subscribed in this country to the natural right thesis of justification for the law of copyright."[46]

Senator Hatch's bill, renamed the Copyright Term Extension Act of 1996, was approved by the Senate Judiciary Committee on May 23, 1996 by a 15-3 vote.[47] Meanwhile, Senator Brown introduced in committee an amendment "to deny any extension of copyright term to corporate copyright owners," (that is, works made for hire) but his measure was defeated by a vote of 12-4. The Committee noted that the corporate extension was necessary to achieve harmonization with the European Union, and it cited technological changes and increased marketability as a second rationale for defeating the Brown amendment:[48]

Despite the endorsement from the Judiciary Committee, S. 483 was never put to a vote on the Senate floor because of a disagreement over music licensing,[49] a feature of the second part of the bill.[50]

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[46] *Ibid.*
[47] *CQ Weekly*, "Panel Approves Extension of Copyright Expiration," May 25, 1996, p. 1459.
[48] Senate Committee on the Judiciary Report, 104th Congress, Report #104-315, July 10, 1996, pp. 16-17.
[49] Byrne, B. (2002), p. 16.
[50] The second part of the bill contained a provision exempting proprietors of certain business smaller than 2000 or 3750 square feet (depending on whether the business is a restaurant or not) from paying music licensing fees. Senator Strom Thurmond (R-SC) wanted language inserted to reduce fees paid by restaurants 5000 square feet or smaller, but Senator Hatch and others opposed the broader provision.

In 1997, the 105th Congress succeeded the 104th, and Republican Howard Coble (R-NC) took over the Courts and Intellectual Property Subcommittee of the House. Representative Coble introduced HR 2589 — the bill that would eventually become law as CTEA — on October 1, 1997. The House Subcommittee on Courts and Intellectual Property did not hold hearings on the bill in Washington, D.C., instead meeting in June, 1997 in Memphis, Tennessee—the home of country music--to discuss three issues: "Pre-1978 Distribution of Recordings Containing Musical Compositions; Copyright Term Extension; and Copyright per Program Licenses." The overwhelming majority of witnesses during the hearing were industry and association representatives who favored term extensions. On March 3, 1998 the House Judiciary Committee approved HR2589 by voice vote. Members of the Committee and others stressed the potentially costly trade ramifications of not passing the bill, highlighting the European Union's 70-year copyright term. "As the world leader in the export of intellectual property, this has serious trade implications for the United States," said Coble.[51] The bill was passed by the House 22 days later on a voice vote.

Opponents of the music licensing section of the bill moved their fight to remove this section to the Senate Judiciary Committee where they had significant support. In response, Walt Disney Pictures commenced a concerted lobbying effort to save the bill, arguing that the copyright on Mickey Mouse—Disney's most precious asset with a copyright set to expire in 2003—must be extended. Copyrights on Pluto were set to expire in 2006 and on Goofy in 2008. Expirations would then come in rapid succession for Bambi, Dumbo, Donald Duck, Snow White, and the Seven Dwarfs.

[51] *CQ Weekly,* "Panel Approves Extension of Copyright Protections" March 7, 1998, p. 561.

On Oct 7, 1998, the Senate enacted the Sonny Bono Copyright Term Extension Act, and President Clinton signed the bill into law on Oct 27, 1998. Since the passage of CTEA, there have been no major changes in U.S. copyright terms.

III. A Brief Discussion of U.S. Copyright Term Structure

The current U.S. copyright term for natural persons is structured as 'authors' life time plus a fixed period of time'. This structure was adopted in 1976 to conform with the Berne Convention and international practice. It also nicely exemplifies the two motivations in the making of copyright law – moral and economic–which will be expounded in the following analysis.

The view that copyright terms should be related to life expectancy is closely related to the moral right (or natural right) doctrine derived from the Lockean view that a creator should be entitled to every right over what he/she creates. It implies that if one "mixed one's labour" with nature, then one had a legitimate and permanent claim to the ensuing product. Nonetheless, this view had been increasingly challenged. Creation has becoming ever more dependent upon the ideas and expressions that already exist. Newton's famous reference to his accomplishments, "If I have seen further it is by standing on the shoulders of giants," is a great illustration of it. It is enormously difficult to find a creation that is completely isolated from past creations. Because of this, it is generally implausible to claim a permanent right over a creation finding life from the cumulative efforts of past generations.

The Lockean view explains in part why the U.S. Constitution's Copyright Clause is interpreted by many legal copyright scholars as a social bargain, with both rights (exclusive use) and obligations (rights expire after a limited time) for the copyright holders. An unduly long control over intellectual property rights could impede future creations, if there are high costs of transacting or royalty fees with high monopolistic

premiums. From a historical perspective, the existence of tightly linked chains of innovation argues against perpetual intellectual property rights.[52]

A hypothetical pure life term (life long protection) might be perceived as a compromised morality-inspired right because of its impermanency. It has advantages such as automatic adaptation to the author's life span *plus* provision of incentives for earlier creation, as discussed in the previous section. It also ensures that the author's right over his work does not expire during his lifetime.

Assuming copyright protection sufficiently motivates creation, this incentive mechanism operates through a "preferential treatment" – favoring early creation in the authors' life and disadvantaging late creation. This scheme tends to insufficiently reward those who create later in their life and could reduce their supply of creative works. It also raises equity concerns, as elderly authors may feel unfairly treated under this scheme, assuming that younger and elder authors are equally productive in creating cultural products of the same quality. In general, it is more desirable for a society to have works created earlier than later as more consumers will be able to enjoy them. Yet it is not completely clear that there is no downside to this efficiency argument, for instance, there may be a "copyright race" in which young authors rush to publish their works that could have been better if they did not race to get copyrights. In addition, a pure life term may not be preferred by individuals. As I prove in Appendix I– *ceteris paribus*, a life term with uncertainty leads to less utility derived from works created. For instance, suppose a risk-neutral person at

[52] It appeared that at least one of the fathers of the United States Constitution was not enthusiastic about attributing intellectual property to the moral right philosophy. Thomas Jefferson wrote that there was no natural right in inventions or ideas. Jefferson believed that: "Ideas should freely spread from one to another over the globe, for the moral and mutual instruction of man, and improvement of his condition…" This is why nature made ideas, "like fire, expansible over all space… and like air…incapable of confinement or exclusive appropriation." Societies may choose to protect the property of ideas in order to encourage useful inventions. Elsewhere, Jefferson indicated that he approved of such protection, but also that there is no natural right to the protection of this form of property (Yarbrough 1989).

the age of 30 expects he will live to 70. A fixed term of 40 years will generate more utility for him/her than a random term with an expected value of 40 years.

In contrast, a fixed term helps to remedy problems with insufficient compensation and equity associated with a life term. It also helps to eliminate income uncertainty by providing an insurance-like monopoly right over the work for a fixed number of years. An author can be assured that the author's family will continue to derive income from the work even if the author's life is cut prematurely short.

Nonetheless, the fixed term fails to retain positive elements of the life term such as automatic adaptation to varied life expectancy. And it does not encourage the early creation preferred by society.

Therefore, the structure of life-plus-fixed-term is a reconciliation of the two composing elements. This hybrid structure maintains the features of pure life term and fixed term: protection covering life time, encouraging early creation, and certain degree of equity. While the hybrid structure of copyright terms allow for a number of important factors to be accommodated, the economics literature has not developed a formal model to assess whether this structure of protection is optimal and whether the length of the copyright term provides too little or too much protection to authors.

IV. The Legal Battle

CTEA's passage prompted corporations, associations and individuals that rely on creative works in the public domain to bring a challenge to its constitutionality. Eric Eldred–an online publisher drawing resources from the public domain–and several other parties filed a law suit in D.C. District Court against

former Attorney General Janet Reno in her official capacity, challenging CTEA's constitutionality on January 11, 1999.

Plaintiffs alleged that CTEA violated the First Amendment because "[t]he First Amendment restricts Congress's power to 'make' any law 'abridging the freedom of speech, or of the press.'"[53] In other words, CTEA restricts plaintiffs' freedom of speech. They also charged that the retrospective extension of copyright protection is beyond Congress's enumerated power under the copyright clause.

On October 28, 1999, Judge June Green granted summary judgment to the government dismissing the plaintiffs' arguments. She made two central arguments. First, CTEA does not violate the First Amendment because there is no First Amendment right to use the copyrighted works of others. Second, she found that CTEA does not violate the Copyright Clause of the Constitution – that the Congress is granted the right "to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."[54] The retrospective extension of the Act is within Congress's power under the Copyright Clause, as the "limited times" period is subject to the discretion of Congress.[55]

The plaintiffs appealed the District Court's decision. In an opening brief to the D.C. Court of Appeals, they argued that CTEA, in both its prospective and retrospective applications, fails the intermediate scrutiny test appropriate under the First Amendment. In addition, they argued that CTEA's retroactivity violates the originality requirement of the Copyright Clause. Finally, they argued that CTEA's extension

[53] See United States District Court for the District of Columbia, Case No. 1:99CV00065.
[54] See U.S. Constitution, Article I, §8, Clause 8.
[55] See United States District Court for the District of Columbia, CA 99-0065.

of copyright terms goes against the "limited times" requirement of the Copyright Clause—a requirement they say is informed by the goal of "promot[ing] the progress of science and useful arts."[56]

The DC Court of Appeals turned down the plaintiffs' appeal. Judges Ginsburg and Henderson of the DC Court of Appeals rejected plaintiff's arguments:

> Their First Amendment objection to the CTEA is invalid because the plaintiffs lack any cognizable first amendment right to exploit the copyrighted works of others. A work with a subsisting copyright has already satisfied the requirement of originality and need not do so anew for its copyright to persist. Further, the argument 'that the introductory language of the Copyright Clause constitutes a limit on congressional power' is unwarranted.[57]

Judges Sentelle dissented. He asserted that the Copyright Clause does substantively limit Congressional power. The Congress is empowered to "promote the progress of science and useful arts"; it is not granted the power to secure exclusive rights. Further, he argued that the Framers of the Constitution would never have contemplated permanent protection, either directly obtained or attained through the guise of progressive extension of existing copyrights.[58]

Plaintiffs appealed to the U.S. Supreme Court and renewed their contention that the CTEA fails constitutional review under both the Copyright Clause's "limited time" prescription and the First Amendment's free speech guarantee. The petitioners maintained that Congress went awry, not with respect to newly created works, but in enlarging the term for published works with existing copyrights. The "limited time" in effect when a copyright is secured becomes the constitutional boundary, a clear line which Congress has no power to extend.

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[56] See United States Court of Appeals for the District of Columbia, CA 99-5430.
[57] 239 F.3d 372, 345 U.S.App.D.C. 89.
[58] *Ibid.*

The Supreme Court granted certiorari on February 25, 2002. Oral arguments were heard on October 9, 2002. The Supreme Court delivered its opinion, Eldred v. Ashcroft,[59] on January 15, 2003 upholding the District Court and the Court of Appeals decisions by a vote of 7-2. Justice Ruth Bader Ginsburg on behalf of the majority of the Justices asserted that it has been the practice of virtually every past copyright term extension that the extension applied to both existing and future works. CTEA's terms, though longer than the 1976 Act's terms, are still limited, not perpetual, and therefore fit within the discretion of Congress. She also cited the issuance of the European Union directive, and demographic, economic and technological changes as foundations for Congress to extend copyright terms.[60]Justice Ginsberg also argued that it is not the Court's role to alter the balance that Congress has labored to achieve in this area of the law.[61] The majority of Justices demurred to the petitioners' description of the Copyright Clause as a grant of legislative authority empowering Congress "to secure a bargain —this for that." They, however, held that the legislative evolution demonstrates that a copyright is not only for the time when protection is gained, but also for any renewal or extension legislated during that time when copyright is in force.[62]

First Amendment scrutiny was rejected because copyright law incorporates its own speech-protective purposes and safeguards, i.e., the dichotomy between ideas and expressions strikes a definitional balance between the First Amendment and the Copyright Act; the Act permits free communication of facts and ideas while still protecting an author's expression. Additionally, "fair use" allows the public to use not only facts and ideas contained in a copyrighted work but also expression itself in certain circumstances.

Justices John Paul Stevens and Stephen Breyer dissented from the Supreme Court's decision.

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[59] 537 U.S. (2003). Opinion of the Court.
[60] *Ibid,* p.2.
[61] *Ibid*, p.4.
[62] *Ibid*, p.24.

Justice Stevens maintained that: "... the majority's contrary conclusion rests on the mistaken premise that this Court has virtually no role in reviewing congressional grants of monopoly privileges to authors, inventors and their successors, I respectfully dissent." He affirmed that "[o]ne must indulge in two untenable assumptions to find support in the equitable argument offered by respondent—that the public interest in free access to copyrighted works is entirely worthless and that authors, as a class, should receive a windfall solely based on completed creative activity." With regard to the precedent of Congress enacting similar legislation, Justice Stevens held that a more complete and comprehensive look at the history of congressional action under the Copyright/Patent Clause of the U.S. Constitution demonstrates that history, in this case, does not provide the "volume of logic".[63] Justice Breyer in his dissenting opinion stated that the economic effect of this 20-year extension—the longest blanket extension since the Nation's founding—is to make the copyright term not limited, but virtually perpetual. Its primary legal effect is to grant the extended term not to authors, but to their heirs, estates, or corporate successors. And most importantly, its practical effect is not to promote, but to inhibit, the progress of "science"—by which word the Framers meant learning or knowledge. The majority believes these conclusions rest upon practical judgments that at most suggest the statute is unwise, not that it is unconstitutional. Justice Breyer argued that the failings of degree are so serious that they amount to failings of a constitutional nature. Although the Copyright Clause grants broad legislative power to Congress, that grant has limits. And in his view this statute falls outside them.[64]

Hence the litigation concluded with the U.S. Supreme Court clearly rebuffing the plaintiffs' challenge to CTEA. While the legal encounter ends with a victory for the proponents of copyright term extension, it also highlighted arguments that CTEA may produce few significant incentives to create new works and that it had the effect of transferring wealth from consumers to holders of copyrights. Although the legal

[63] 537 U.S. (2003). Stevens, J. dissenting, p. 13.
[64] 537 U.S. (2003). Breyer, J. dissenting, p. 2.

foundations of CTEA are relatively clear, it is still necessary to analyze CTEA using economic analysis to determine whether its provision are likely to increase social welfare and to assess whether the U.S. Congress will continue to extend copyright terms as the intellectual property assets of major corporations near expiration.

V. A Review of the Economic and Legal Literature on Copyright Terms

Before examining the arguments set forth by proponents of the CTEA, a brief review of the economic studies pertinent to copyright protection may be helpful.

Regarding the economics of copyright duration, Landes and Posner in their seminal 1989 study bring forward the following guidelines as to optimal copyright protection:

1. The optimal extent[65] of copyright protection is greater for classes of work that are more valuable socially. The value of work is greater the greater the demand for the work and the lower the marginal cost of making copies. Thus if, over time, growth in income and advances in technology enlarge the size of the market for any given work and reduce the cost of copying, then copyright protection should expand if social welfare is to be maximized.
2. If the value of a work is less affected by the extent of protection, protection should be strengthened because of the benefit in increasing the number of works.
3. The more the cost of expression[66] increases as protection tightens, the lower will be the optimal level of copyright protection.
4. The greater the administrative and enforcement costs, the more lax protection should be.

[65] Note that this is a comprehensive index of copyright protection that may include the duration, breath, and strength of enforcement.
[66] This is defined as the additional cost of creating new works due to current copyright protection of existing works.

5. The more responsive of number of works created to an increase in protection, the greater the optimal value of copyright protection must be.

Novos and Waldman (1984) modeled copyright as a deterrence instrument that increases the marginal cost of each illegal production. They found that stronger protection tends to increase social welfare. Kolbolt (1995) used reasoning similar to Novos and Waldman (1984). He modeled copyright on the basis that protection has the effect of increasing the marginal costs of commercial production and found support for a minimum level of protection and a reason for limiting the extent of protection. Richard Watt (2001) extended Kobolt's (1995) model by recognizing that the cost faced by the pirate under copyright law is stochastic. He shows that social welfare is maximized when the protection is neither so strict as to eliminate all piracy, nor so lax that piracy is rampant. Reichman (1996) provided an in-depth analysis of the extension from a legal standpoint. In particular, he examined the harmonization of U.S. law and the E.U. Directive and concluded that it was the "Unattainable Goal of Uniform Law". Further, he proposed the concept of "cultural policy" in an attempt to reconcile the incentive paradigm and the moral rights perspectives. Reichman argued that copyright term extension is premature and counterproductive, as longer copyright terms are empirically unjustified and may adversely affect the balance of trade.

Next, we might consider patents and copyrights to be two polar cases in one category. The scope of copyright is narrower, covering expression only and allowing for more close substitutes; the scope of patents is broader, since it protects the idea embodied in the technology and tends to exclude close substitutes from the market. In view of this, findings on patent duration may shed light on copyright duration.

In his classic study of patents and technology, Nordhaus (1969) examined optimal patent lives. His analysis showed that commodities with lower elasticities of demand have higher optimal patent lives. Consider that copyrighted works have narrower scopes and more close substitutes, thereby higher elasticities of demand. According to this extension of the Nordhaus theory, copyrighted materials should be protected for a shorter term than patented technology. Protection is, however, actually longer for copyrighted works than for patents. Second, it was shown that since different industries have different technological climates, innovations in industries with more rapid and progressive technological change should have shorter lives. Klemperer (1990) showed that if demand is relatively more elastic in reservation price than in substitution cost, then society should generally be more concerned with under-consumption and so should narrow patent scope to ensure low prices; if the converse is true, society should generally be more concerned with substitution within the product class and hence should broaden the patent's scope. Gilbert and Shapiro (1990) showed that the optimal policy calls for infinitely-lived patents whenever patent breadth is increasing costly in terms of deadweight loss. Denicolo (1996) reexamined the optimal patent breath by extending the earlier literature to the case where many firms are involved in an R&D race for a patent. The disparate natures of competition might explain the diverse results in the literature. In particular, the less efficient is competition in the product market, the more likely it is that broad and short patents are socially optimal. Extending this analysis to copyrights, Denicolo finds that copyrights terms should be longer than patent terms.

VI. Proposed Rationales For Term Extension

A. Longer life Expectancy and Increased Concern for the Wellbeing of Heirs

A notion that was given serious consideration in the CTEA congressional hearing was the increase in life expectancy in the United States in the 20 years preceeding the hearing. Combining the increase in life

expectancy with the assumption that people care about the well being of their descendents, proponents argued that the increased life spans (of the author and the author's descendents) would warrant a twenty-year extension. As George David Weiss, the President of The Songwriters Guild of America, stated in a Congressional hearing in 1997:

> One reason that congress has previously extended the copyright terms was to protect not only the creator but his or her children and grandchildren – that is, three generations. To some, the current term of protection in the United States must seem like a long enough time to meet this goal. But things have changed, even since last term extension in 1976. Like everyone, we songwriters are now living longer – thank the good Lord and science – and increasingly many of us are blessed with children later in life. Particularly with respect to older works, these facts strongly militate in favor of a 20-year extension.[67]

1. The Demographic Argument

The life-plus-fixed-term composition of the current term of protection allows for adequate flexibility that accommodates the variation in longevity. If average life-expectancy increases, then the term of protection is automatically extended without the need to go through legislative procedures because the term of protection already incorporates the author's life span.

Nonetheless, it allows for flexibility and coverage with regard to the variation in life span of the author and does not adjust for increases in the life expectancy of the author's descendents. Therefore, it remains uncertain to what extent Congress should expressly take into account the descendents' well being. The assertion of copyright protecting one's grandchildren, despite its moral appeal, is in stark opposition to the American values of "self-reliance" and "entrepreneurship". Considering this factor may force legislators to make a decision that undermines the American value of industriousness in the name of

[67] Hearing before the subcommittee on courts and Intellectual Property Rights Committee on the Judiciary House of Representatives, 150th Congress, June 27, 1997, p. 36.

protecting the fruits of it. On the other hand, the Constitution provides that the objectives of IPRs are to "promote the progress of useful art and science". It is a leap of faith that extending protection to descendents will produce additional creative activity.

From 1976—when a major revision of copyright law set copyright terms at an individual author's life plus 50 years—to 1997, American's longevity increased by less than 5 years for the overall population and for the male, female, black and white populations (see Table 2). As there is no evidence that copyright holders as natural persons have had a larger increment in longevity than the average person, five years of additional life expectancy among Americans does not seem to justify a 20-year increase in copyright protection.

Further, demographic change does not appear to be relevant to the corporate-owned copyright extension. In the United States, the corporate copyright is detached from the longevity of a natural person. It is 75 years before CTEA and 95 years after. By contrast, in Europe corporate copyrights are specified as the last surviving author's life plus 70 years. Since copyrights in the United States are structured in a way that is independent of the life expectancy of their creators, a term extension for corporate copyrights cannot be justified on the basis of increased life expectancy.

Finally, assuming the current copyright term under the life-plus-fixed-term structure is optimal, *ceteris paribus*, longer life expectancy should result in a reduction in the fixed portion of then copyright term to keep the total number of years of protection constant. For instance, if author's life plus 50 years is considered the optimal term of protection, all else equal, 20 additional years of life expectancy should result in the fixed term being reduced to 30 years to keep the overall period of protection optimal.

2. Added Incentives Stemming from the Term Extension

CTEA supporters implied in their testimonials that the current copyright terms needed to be extended to properly incentivise authors due to increases in life expectancy.

In order for an income stream occurring at the end of the author's life plus 50 years to have a significant impact on current creative activities, one needs to make several strong assumptions. First, the discounted present value of income has to be significant; second, monetary incentives must play a large part in creation as opposed to other incentives such as publication, reputation, and the award of professorial positions; third, creative activities must be sufficiently sensitive to monetary rewards; fourth, income must still be flowing from the creative work more than 50 years after the author's death; and, finally, in the case of retroactively applied copyrights, the windfall on past works has to be an impetus for future creations, which is a fairly curious hypothesis.

In their amicus brief, seventeen prominent economists, including a Nobel Prize laureate, wrote: "It's highly unlikely that the economic benefits from copyright extension under CTEA will outweigh the costs."[68] In addition to the social costs that copyright extension entails, "the CTEA's longer copyright for new works provides at most a very small incentive."

To illustrate this example in the amicus brief, the economists analyzed the case of an author who writes a book and lives for thirty more years. In this case, under the pre-CTEA copyright regime, the author or his assignee would receive royalties for eighty years. In this example, the present value of total additional

[68] Please see http://supreme.nytimes.findlaw.com/docket/2002/october.html.

revenues under the CTEA can be calculated by adding up the present values of revenues from year 81 through year 100. Assume that the work produces a constant stream of revenues and that the discount rate is 7%. In this case, the present value of the total return from years 81 to 100 is 0.33% of the present value from years 1 to 80. Put differently, under these assumptions, the additional compensation provided by the 20-year term extension amounts to a 0.33% increase in present-value payments to the author.[69]

The economists further acknowledge that this estimate tends to overstate the effect for two reasons. First, it is assumed in the calculation that the income stream is constant; in reality, the income stream is more likely to have declined or be zero. Second, a more realistic discount rate might be higher than 7% due to the risky nature of uncertain future income streams.[70]

David Levin evaluates copyright term extension by directly examining whether it has led to increased output of creative works:

> Beginning in 1919, the length of copyright … roughly doubled during the course of the century. If this approximate doubling of the length of copyright encouraged the production of additional literary works, we would expect that the per capita number of literary works registered would have gone up. Below is a graph of the number of literary copyrights per capita registered in the United States in the last century… As predicted, the various copyright extensions have not led to an increase in the output of literary work.[71]

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[69] *Ibid.*

[70] If the interest rate is 3%, the present value of the total return from years 81 to 100 is 4.6% of the present value from years 1 to 80.

[71] See http://www.dklevine.com/general/intellectual/copyrightextension.htm.

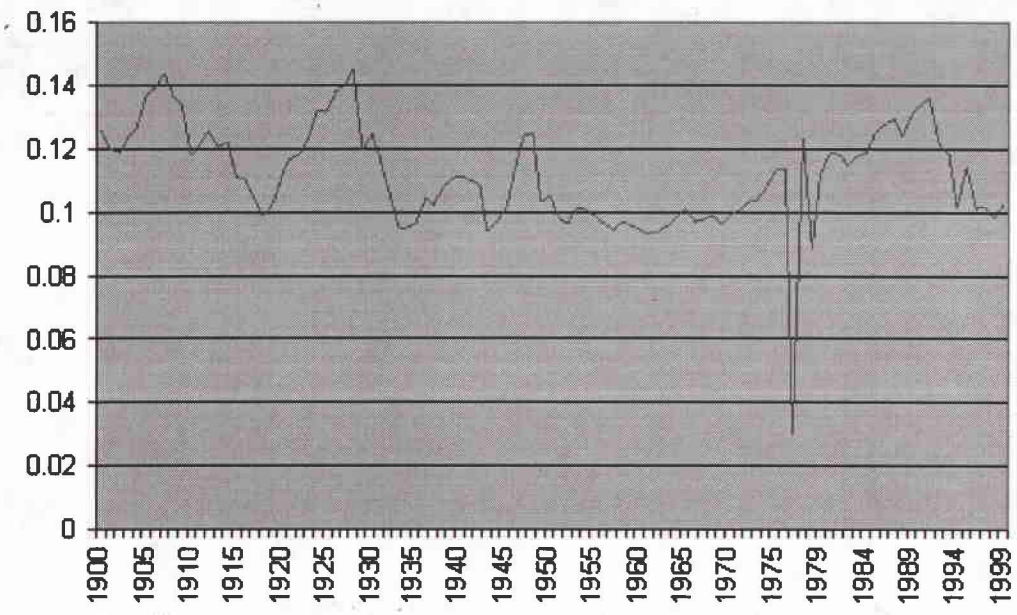

Figure 11 Per Capita Number of Literary Works in the U.S. in 20th Century

B. Harmonization of Copyright Protection with the European Union

Proponents of CTEA frequently argued that the shorter U.S. copyright term—compared to the EU—would have produced substantial economic losses for the United States and adversely affected its trade balance. Among others, George David Weiss, the President of the Songwriters Guild of America, argued:

> Most importantly, a change in the copyright term in Europe has made the US 'out of the tune' internationally. On July 1, 1995, in line with a 1993 directive, the European Union harmonized the copyright term in all its member countries at a minimum period of life of the author plus 70 years. This same EU Directive explicitly required that all member states adopt the 'rule of the shorter term' with respect to the duration of copyright protection for foreign works in their countries. This means that if term extension legislation is not enacted and the current US term of life of the author plus 50 years is not extended, EU countries need not provide copyright

> protection to American works beyond life-plus 50 years. American songwriters and other rights holders will thus have 20 years less protection in Europe than our European counterparts.[72]

To evaluate this assertion, I begin by providing a brief review of the history of the EU Directive. The EU Directive was issued in 1993 in the general context of the preparation for a more unified European Community; it represents a small step in the direction of harmonizing IPR legislation across the member countries. However, it is worth noting that the Berne Convention and the World Trade Organization (WTO), organizations to which all EU countries are members, do not require their members to adopt a "life plus seventy" years term, but only a minimum term of "life plus fifty" years. The reason for the EU's choice of "life plus seventy" was not explicitly given by the European Commission, but could have been motivated by the moral right tradition of European countries. The objective of the U.S. copyright law as specified in the US Constitution—"promoting the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries ..."—is widely regarded as a utilitarian rule aiming at promoting the general welfare of the society.[73] Thus, the underlying principles of copyright legislation in the EU are fundamentally different from those in the United States. Legal scholars have voiced concerns that harmonization of copyright terms compromises the U.S. utilitarian doctrine.

Further, the EU Directive may violate Article 4, the most-favored-nation and national treatment clause, of the Trade-Related Intellectual Property Rights (TRIPs) agreement, to which both the European countries

[72] Hearing before the subcommittee on courts and Intellectual Property Rights Committee on the Judiciary House of Representatives, One hundred fifth congress, June 27, 1997, Page 35.

[73] In fact, the TRIPs Agreement governing intellectual property rights protection in most countries in the world is even more explicily utilitarian, as it provides in Articles 7 and 8 that "[t]he protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations". See http://www.geneva.quno.info/pdf/OP10%20JH.pdf, p. 10.

and the United States subscribed.[74] It prevents one member country from conferring a more favorable economic treatment to its own nationals than foreigners.[75] The EU Directive falls into this category by offering its own citizens a term of "life plus seventy years" and foreign nationals "life plus fifty". These unsettled issues indicate that the United States should have been more cautious before it enacted legislation to harmonize with the EU.

A harmonized copyright protection across countries is desirable, though perhaps not for the reasons that CTEA proponents have raised. First, under a harmonized system, the same work could not be under copyright protection in one country and beyond the term of copyright protection in another country. In the internet age, a book, movie or music score can easily be posted on the World Wide Web and be shared with millions around the globe. This increases the difficulty of enforcing copyright laws in countries with longer terms of protection. Second, a harmonized system could reduce transaction costs adhering to copyright registration; a uniform system of copyright terms and registration procedures would greatly facilitate the provision of copyright protection across borders. Third, harmonization could also help copyright holders bring litigation against violators in foreign courts. This is, in part, the rationale for the requirements in the TRIPs Agreement for a minimum copyright term in all member countries.

Nonetheless, CTEA does not actually achieve the desired goal of harmonization. Despite the claims of CTEA advocates, Table 1 shows that CTEA does not produce uniformity except in copyrights in new, post-1977 works attributed to a single author and joint authors.[76] Only 2 of 20 categories were actually harmonized. Ten other categories–for works by natural persons published before 1978, works by joint authors before 1978, works made for hire before 1978, audiovisual works before 1978 and sound

[74] Bard and Kurlantzick (1999), p. 15.
[75] Reichman (1995)
[76] Compare 17 U. S. C. §302(a) with EU Council Directive 93/98, Art. 1(1).

recordings before 1978–are not in harmony but will eventually become irrelevant with the passage of time. In certain cases, U.S. protection now substantially exceeds EU protection. Consider the works of Sir Arthur Conan Doyle. The copyright to his last book under the U.S. term extension will expire in 2022. In Europe it will expire in 2001.[77]

In addition, most EU countries do not recognize corporate copyright ownership—that is, works not owned by individuals, a category which is recognized in the United States. Those EU countries that do recognize corporate copyright ownership provide less protection (70 years) than the United States does under current law (75 years). Yet the CTEA extends these terms another 20 years to provide 95 years of copyright protection. Rather than harmonizing American and European copyright terms, CTEA widens the differences[78]. Similarly, copyrights on sound recordings in Europe expire 50 years from the earliest of either the first publication date or the first communication to the public. Before CTEA, U.S. copyrights on sound recordings lasted 75 years. CTEA extended copyrights in this category to 95 years, opening a vast gap between the U.S. and European terms.

To summarize, even though it is desirable to harmonize the copyright systems, different philosophies underlying copyright legislation in the United States and Europe may create frictions. Different uses of life and fixed terms in the United State and the European Union create technical difficulties for harmonization. Under close examination CTEA does not harmonize with the European system in many

[77] Sir Doyle died in 1930 and his works have copyrights until 2001. In the United States, works first published before 1978 have a 75-year period of protection rather than the current life + 50 term as in Europe, which is extended by CTEA to 95 years. Because his last work was published in 1927,[77] it is scheduled to go into the public domain in the United States at the end of the year 2002, about the same time as the revived European copyrights on his entire oeuvre. The extension would reintroduce "disharmony" for his later works until the year 2022. See Karjala (1997)

[78] Most European nations' copyright laws do not possess a corporate/individual work dichotomy, making it difficult to gauge how work for hire durations will be treated internationally. Bard and Kurlantzick (Supra note 48) are among those who argue against the European extension being relevant to U.S. works for hire.

creative categories. In some categories, the new terms extended by CTEA are much longer than those in the European Union. It is a strange "harmonization" law that allows serious gaps in copyright terms to be lengthened rather than closed.

C. Balance of Trade

Proponents of term extension have also argued that the harmonization with European Union would improve the U.S. trade balance. Again, as George David Weiss has argued:

> It has often been said that the whole world loves American music. Our intellectual property generally is the most sought after abroad and is one of the few bright spots in our balance of trade. According to a report issued in March of this year musical recordings, movies and home videos, television programs, books, and computer software – represent a huge bonanza of foreign sales, totaling over $53 billion in 1995. This surpasses every other export category but the automotive and agriculture sectors. The equation is simple: we are a net exporter of intellectual property products to the EU; if we increase our copyright term to life plus 70, we will gain an additional 20 years of foreign revenues from EU and our trade balance will improve in the long run.[79]

Weiss has correctly pointed out that the extended period of protection will play a role in international trade, yet there are other relevant factors that he failed to consider, such as the importance of a trade imbalance; the effectiveness of using copyright terms as instruments to improve the trade balance; and the costs entailed by prolonged copyright terms. Most fundamentally, making trade policy to create a trade surplus is the essence of mercantilism, a totally discredited economic doctrine. Such policies also invite retaliation from trade partners. Even if initial application raises the country's trade surplus, such effects typically disappear after trade partners have retaliated with similar policies. Let us consider several arguments in more depth.

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[79] Hearing before the Sub-Committee on Courts and Intellectual Property Rights Committee on the Judiciary House of Representatives, 150th Congress, June 27, 1997, p. 35.

First, in an open economy, trade imbalances are corrected by adjustments in exchange rates, prices, and incomes. They are not necessarily signs of economic weakness. An economy with a trade deficit may have lost its competitive edge or it may be importing foreign capital to take advantage of an excellent investment climate. Second, A deficit does not necessarily call for a protectionist shield that isolates import-competing industries from international competition. Such protection can reduce the import-competing industry's incentives to reduce costs and improve its products. Finally, using parallel reasoning, there is also no need to manipulate trade policy to further a surplus.

To take a step back, even if we are concerned about a trade deficit, it is unclear whether increases in copyright terms will be a significant tool in resolving it. The works that are about to enter public domain were created in 1920, and while European may take more of our current works than we take of theirs, that is not necessarily true of works from the 1920s and 1930s. The use by Americans of European works of classical music and plays as well as art works from this era could well outweigh the use which Europeans make of American works from the same period.[80] A dynamic view also affirms that the production of these works in other developed and developing countries is also vibrant. It is not indisputable that U.S. cultural and high technologies industries will remain as strong in the future as they are currently. This makes the trade argument an opportunistic, economically unsound claim, as proponents would argue for a shorter copyright term if the United States were to become a net importer of copyrighted goods.

Further, to gain additional revenues from European countries, more burdens are concurrently being placed upon the American public. In the absence of change, the twenty years during which Europeans do not pay royalties on American works are also twenty years during which Americans do not have to pay on both American and European works. From the American producers' perspective, they would not only

[80] As Dennis Karjala commented at the 1995 Senate hearing. See http://homepages.law.asu.edu/~dkarjala/OpposingCopyrightExtension/.

gain additional revenue from foreign users, but also gain at the expense of domestic consumers, and the latter will most likely pay much more than the former.

Further, while the transfer from American consumers to producers may be viewed as internal wealth redistribution, the deadweight losses are net losses to the economy. The deadweight losses may be both dynamic and static. The dynamic costs essentially refer to the cost of expression which has a restraining effect on the future creations of the society due to prolonged monopoly over the product. Static costs, meanwhile, are the social costs attributed to under-use and under-production of a product desired by consumers. With 20 more years of copyright protection, these costs exist as long as the protected products are still in demand.

D. Technological Change

The discussion of CTEA inevitably touches upon the issue of the long-run trend in copyright protection, especially when taking into account the advent of the digital information era.

One of the most appreciable changes is that the costs of making copies of the original literary or artistic works are much lower than previously. The arrival of the Internet and, for instance, technologies like Napster that facilitate "peer-to-peer" music exchange has brought music literally "at your fingertips" with low costs. Consumers can acquire a song track with a "click of the mouse". The marginal cost of production for an additional consumer shows a pronounced decreasing trend. Modern technologies have allowed a person without sophisticated technical background to make nearly perfect copies of cultural

works, especially digital works.[81] Meanwhile, it is ever more difficult to detect unauthorized copying of cultural works, which has made its way from office photocopiers to bedroom computers. To detect such behavior, law enforcement authorities face charges of intrusion into citizen's private spheres, implying that more resistance should be expected from consumers against further enforcement as it will be perceived as interference with their personal life and decisions.

The online publishing technologies also made it much easier for news to be instantly delivered to the hands of customers. For example, *The Wall Street Journal* and *The New York Times*, have content online either free to the public or applying restricted access to subscribers only. Online magazines also boomed to take advantage of the low distribution and promotion costs. Individuals who otherwise would have had a difficult time publishing through the conventional media have shown great enthusiasm to "blog" (or post) online. The ease of publishing and the rapid access to copyright protection (which only takes a mark on the work) contributed to a rapid increase in the ocean of "content". The sheer volume and pace of information flow has made copyright infringement happen at a far greater frequency.

Besides the above mentioned aspects that seem to erode the producers' ability to appropriate profits, new technologies also promise to deliver some of the countervailing tools. Hi-tech internet policing systems are developed there is a demand for them. With the aid of a sister Act of the CTEA–the Digital Millennium Copyright Act of 1998[82]—the content industry stepped up their efforts to find copyright infringements. They deployed automated programs that roamed the internet searching for signs of infringement and suspicious sites as candidates for litigation. In 1995, multiple access-control

[81] Although digitized copies of works in certain categories are less of a substitute for the originals than those in other categories, (for instance, online paintings can hardly replace seeing the original in a museum), digitized copies of music and literary works are in fact the same as the originals (except for packaging), if one takes the original as the manufactured CD or e-book rather than the live concert.
[82] Pub. L. No. 105-304, 112 Stat. 2860 (1998).

technologies appeared under the name of "electronic rights management systems." Commercialized in 1996, they were designed to encrypt digital recordings but were not widely used.[83]

Important progress is being made on the theoretical front concerning the nature of technology, the production of knowledge products, and their policy implications. Nonetheless, there has not been a consensus among theorists on how changes in technology should affect optimal social policy. For decades, the conventional wisdom is that the non-convexity (substantial investment followed by much lower marginal cost of each unit produced) and externality (product developer's economic gain is less than the social gain) inherent in intellectual products mandate that a monopoly right be granted to recoup fixed cost despite its attendant costs. In addition to supporting the existence of intellectual property rights in general, these studies also hold that technological change, i.e., lower copying costs, will help make a strong case for non-convexity and externality; therefore copyright should be stronger in the face of technological changes. Landes and Posner (1989) emphasized that protection should expand as technologies keep reducing the marginal cost of producing copies.

Boldrin and Levine (2002) show that if this is the case—that it costs exactly *nothing* to reproduce ideas, then the first purchasers of intellectual property will not pay enough to cover the costs of developing the embodied ideas. But in practice, it *does* cost something to reproduce ideas (especially when it involves absorbing ideas for further reproduction like in pharmaceuticals), although this cost may be small. With a small, positive reproduction cost, the first sale of an intellectual property may, in fact, generate sufficient profits to cover development costs. In other words, the difference between "zero" costs and "small" costs of reproduction may be far greater than one might assume.[84][85]

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[83] See Litman (2001).
[84] See http://www.researchoninnovation.org/tiip/archive/2003_2_a.htm.

Liebowitz (1985, 1986) argued that indirect appropriability is an important way for journal publishers to earn profits. Thus, photocopying of journals in libraries may benefit journal publishers a if publishers are able to effectively charge higher fees to libaries.

The CPB Netherlands Bureau for Economic Policy Analysis (2000) reconfirms that a number of market characteristics need to be taken into account in assessing the ability of appropriation without the presence of copyright. In markets where information has "news value" the need for copyright protection is lower than in the standard case, especially if copying takes time. This is also true for markets where the publisher can internalize part of the value of copies by using price discrimination. In both cases, the publisher can appropriate part of the revenues of the information good, thereby reduing the need for copyright protection. Another insight is provided in markets characterized by "superstars." In this case, copyright protection is less important because most consumers do not know about substitutes for the products of the "superstar". Another element missing in the traditional models is the existence of network effects. Network effects are relevant in markets for information goods where consumers have a higher valuation of the information good when more consumers have bought it. Legal or illegal copies of the information good may add to the network of consumers of a certain good. It can be shown that under certain conditions, copyright protection does not have to be as strong and illegal copying may be beneficial both for the profits of the firm and for social welfare. Litman (2001)[86] documented the competitive pressure that drives intellectual property holders to publish content on the World Wide Web. The *New York Times*, the *Washington Post*, and the *Wall Street Journal* launched hypertext versions of their newspapers, and CNN and ABC News both opened Web sites that allowed browsers to read material

[85] Quah (2002) concurs with Levine's view and shows that markets for IPR-protected cultural assets can produce too much or too little innovation.
[86] See Litman (2001), p 201.

that had been broadcast earlier. These media have survived the shock of the internet and have successfully found ways to market their "content" profitably without much reliance on tightened copyright protection.

In a previous chapter of this dissertation, I apply an optimal control model to illustrate the effect of technological change on copyright protection. I find that to maximize social welfare, the optimal copyright protection should expand in the face of technological change, i.e., reduced copying cost, before gradually falling back to a new steady state. In the event that technological changes happen continuously or nearly so, optimal protection should continuously be strengthened until copying costs do not decline further; at this point, copyright protection will gradually fall back to lower levels.

The above survey of the theoretical literature on optimal copyright policy shows that theoretical studies are still evolving and have not reached an agreement on how advancing technologies interact with copyright protection. Most economists believe that the copyright as a government-granted monopoly is well justified for a limited period of time to provide incentive to authors in their creative activities. Nonetheless, it is debatable as to how long and how strict the protection should be. Empirical estimates of the effectiveness of copyright are needed to help understand whether copyright is too strict or should be differentiated across industries.

However, in any case, it seems that a term extension does not directly address the problem that new technologies make the intellectual properties widely available and that the producers are less able to recover their investments. Suppose a movie is freely accessible on the internet; an extraordinarily long term of protection will yield gains for the producer if the law is poorly enforced. Lower copying and dissemination cost seem to argue for a tightened enforcement of copyright protection regardless of the copyright term.

Much of the revenue appropriation problem can be solved with technological tools and, in some cases, business tools. One may recall that the music and movie industries did not lose as much as they thought they would when audio cassette recorders and video cassette recorders (VCRs) first appeared in the market. To the contrary, these new devices actually served to increase the demand for their product and expand the market. Despite the initial resistance by the music and movie industries, they eventually welcomed and accommodated the new players to share the market with them. The business models of the online music industry have gradually emerged and matured. Napster, the once free online music swapping program that was litigated by music producers, has now become an industry-sanctioned operation. Experiments with different models occurred with *Pressplay* and *Rhapsody*, which charged a monthly fee with restrictions attached – such as no transfers to a CD or portable player and having songs "expire" after some time. Consumers' tepid responses to these ventures prompted developers like Apple iTune, Napster 2.0, and MusicMatch to come up with prototypes for both *a la carte* shopping and subscription service (the standard rate is 99 cents per song, $9.99 for most albums). This reveals that governments can refrain from taking actions in regulating nascent markets and technologies. In stead, it might be better to wait and see if the industries will find optimal solutions through trial and error. Businesses under competitive pressure are often more creative in developing acceptable market solutions than government agencies and academics.

Again as is evident from this example, what may matter is the degree of copyright protection stringency that allows the music industry to file a suit against Napster. The extended protection bears on the new technology and market to a lesser extent.

VII. Retroactivity and the Welfare Impact of CTEA

The arguments raised by CTEA's proponents generally do not lend support to the copyright term extension. So what drove CTEA's passage? Its passage has much to do with its retroactive application. There was little dispute in the Congress as to whether the legislation should be applied to existing copyrights, since most of the past major term extensions applied to both existing and future copyrights.[87] The expectation that CTEA's extension would be retroactive provided strong incentives for copyright holders to lobby for the Act. Why then was retroactivity so important for CTEA's passage?

Economic rationales for retroactivity in public policy usually pertain to the presumption that economic agents might delay changing their actions until the policy reaches its start date. For instance, an expected investment tax-credit will at the margin change the tradeoff of the agents' decision regarding investment decisions. Rational agents might choose not to make an investment before the tax credit is in place. A retroactive application will encourage them to take action now rather than to wait until the Act is passed and signed into law. In the case of retroactive copyright extension, the bill was first introduced in Congress in 1995 and was enacted in 1998. In general, the immediate loss seem to outweigh gains in the remote future. In fact, it is straightforward to calculate using discounting methods that the corporate profit stream 76 to 95 years after, say the movie release, is about only 57% of its profit loss in the first 3 years of distribution under conservative assumptions.[88]

As the Supreme Court stated, "Congress placed existing and future copyrights in parity"[89]. It suggests implicitly that fairness may be what motivated the retroactive extension (for current and past extensions).

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[87] On exception occurred in the copyright extension enacted in 1831. It provided terms of 28 years from publication, renewable for an additional 14 years. Only existing works in their initial copyright term at the time when the Act became effective could qualify for the extension.
[88] I assume that the profit stream is constant and the discount rate is 3%.
[89] *Eldred v. Ashcroft*, 537 U.S. (2003), p 6.

While common in public policy making, it is usually difficult to achieve perfect fairness[90]. For instance in CTEA, Congress strived to put copyrights *created* a few days before and after the effective date of CTEA on a level ground. Yet the copyrights that *expire* a few days before the effective date of CTEA will be treated drastically different from those a few days after the effective date. However, the ramifications of retroactively extending copyright terms are complex.

First, interest groups committed substantial resources to lobby Congress to pass CTEA. Corporations, estates, heirs of authors and composers holding soon-to-expire copyrights were and are greatly motivated to lobby for extensions.

The U.S. movie industry spearheaded the lobbying effort to pass CTEA. Representatives from the industry met numerous times with lawmakers to strike deals on copyright term extension. For instance, at the top of Disney Picture's request list was an appeal for Congress to help Disney's highest priority: the bill to extend the soon-to-expire copyright on Mickey Mouse--Disney's most precious asset. The movie industry's monetary contributions to individual lawmakers or to such agencies as the National Republican Senatorial Committee is well documented.[91] Ten of the 13 initial sponsors of the legislation in the House had received contributions from Disney, which spent more than $1.5 million on lobbying in 1997.[92] Jack Valenti, president of the Motion Picture Association of America (MPAA), also played a vital role by making friends with the Republican-controlled Congress.

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[90] There are various definitions of fairness. It has been suggested that fairness criteria are rather context-specific. Here I assume fairness refers to whether every copyright holder enjoys equal treatment, irrespective of their idiosyncratic characteristics.
[91] See, for instance, http://herndon1.sdrdc.com/cgi-bin/fecimg/?C00197749 or http://www.opensecrets.org/.
[92] Decker (1998).

This brief account reveals a critical link between the industrial capture of the legislation and the fact that copyright term extension was retroactive and is expected to be retroactive in the future. The retroactivity has motivated rent-seeking behavior from many corporations and individuals holding copyrights about to expire. The policy dilemma is manifest here: The pursuit of fairness and equity is also the pursuit of a large windfall and that has generated extensive lobbying. Further, the rent-seeking behavior is not the only effect that a retroactive extension entails.

The attenuation of the public domain over the last century is enormous. The following diagram from the amicus brief of Prof. Peter Jaszi in *Eldred v. Ashcroft*[93] contrasts the size of the public domain under term extensions with the size of the public domain without term extensions.

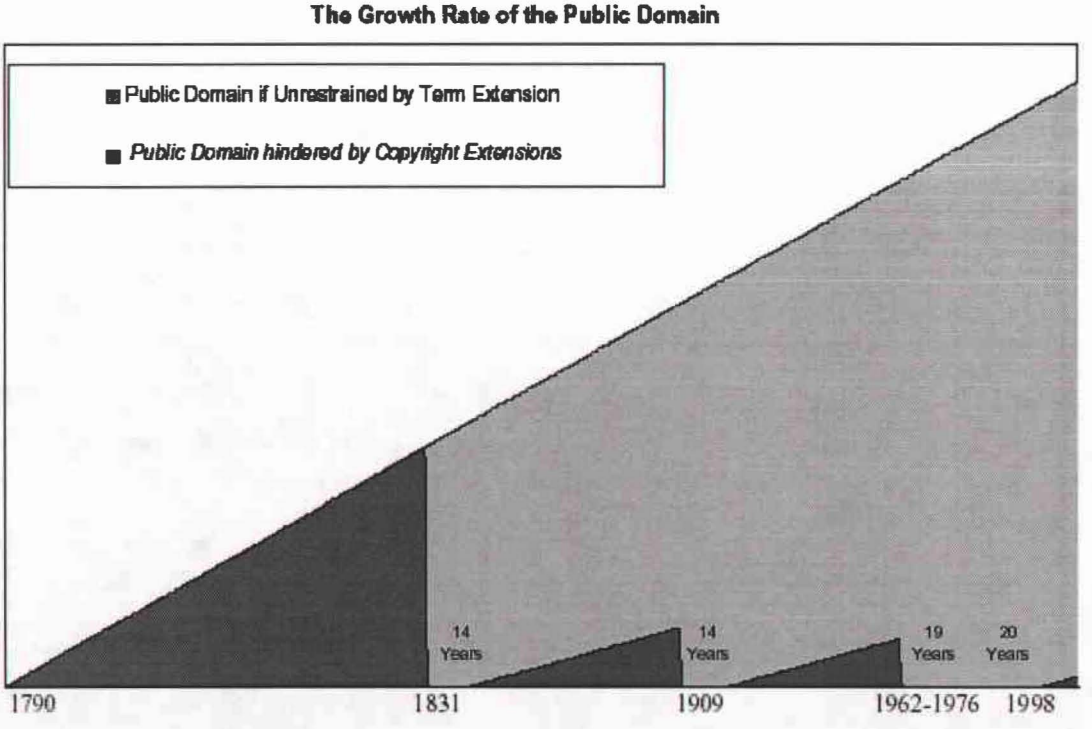

Figure 12 Growth Rate of Public Domain

[93] See http://cyber.law.harvard.edu/openlaw/eldredvashcroft/pubdomain.html.

The cultural material available to libraries, archivists, professors, composers and writers has been markedly reduced. It is in fact the first time in U.S. history that in the 20 years after the CTEA—up to the year 2018, there will be NO works entering the public domain. Given the current strength of copyright protection, Santa Claus would not have gone into the public domain until 1973, and the U.S. government would have had to pay a royalty fee to Thomas Nast's estates before using Uncle Sam's image in all of the last century's wars.

The attenuated public domain has different effects on different uses of cultural materials. It may not matter much in some cases, as the "fair use" doctrine and the expression/idea dichotomy provide much room for later use and creation. For instance, the "fair use" doctrine permits free production of journal articles for academic and research purposes in the library. The expression/idea dichotomy allows authors to conceive a plot with young boy and girl from feuding families falling in love without infringing on the copyright of *Romeo and Juliet* even if it is still under copyright protection, because the idea – plot – is out of the scope of copyright protection, while only the particular expression is. However, the boundary becomes blurred when more works are copyrighted and the concept of expression is in dispute. For instance, Alice Randall wrote a book titled *The Wind Done Gone.* It tells the story of the famous 1936 novel, *Gone With the Wind,* by Margaret Mitchell but from the standpoint of the African slaves. The story is not quite as heroic, not quite as apologetic from Randall's perspective. Indeed, Alice Randall's story is a counter-story to the story that Margaret Mitchell told. The original copyright of *Gone With the Wind* lasted until 1992. The series of copyright extensions, including CTEA extended the copyright to 2031. When Randall's publisher was about to publish the *The Wind Done Gone*, they received a letter from the lawyers representing the Estate of Margaret Mitchell. It indicated that Randall needed to have their permission to publish the book, which Randall deemed unnecessary. Mitchell's estate took legal action against Randall and a federal judge ruled that Randall's new book ought not to be published.

Although the case was eventually reversed in the Court of Appeals for the Eleventh Circuit, it cost Ms. Randall a hefty sum to win and to publish.[94][95] This example shows what can happen when a work is not in the public domain and when the expression/idea dichotomy is no longer unambiguous. In Particular, when the expression/idea dichotomy becomes vague and the use of ideas may infringe on expression, then longer terms or retroactive application may exacerbate the problem.

Similarly, the combined forces of long and broad protection may interact and bring later derivative work producers into an untenable situation, even if "fair use" is permitted. Consider the following example. University of Oregon librarian Christine L. Sundt confirms that some old-time images are of tremendous value to the art history teaching and research. These early images are significant in showing pre-restoration states of the artwork and as such are often very important in art history scholarship. Because these images have little commercial value, they languish with their rights attached so long as they are protected under copyright. Scholars have little hope of getting clearance to publish these images because they cannot determine who the rightful owner is and publishers are reluctant to accept images for which rights are not cleared.[96]

It is apparent that attenuated public domain and long term of protection have caused much unease to the groups that make use of works in public domain for creative enterprises. As seen in the many amici briefs filed for *Eldred v. Ashcroft*, including those from art associations, media centers, cultural heritage

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[94] See Dunwody Distinguished Lecture in Law by Lawrence Lessig, at http://homepages.law.asu.edu/~dkarjala/OpposingCopyrightExtension/commentary/LessigCreativeCommonsFlaLRev2003.htm.

[95] Another example is Rogers v. Koons (960 F.2d 301 (2d Cir. 1992). Jeff Koons used an image from a copyrighted photograph (puppies) and had it transformed by Italian woodworkers into a three-dimensional work. Claiming that the transformation was a parody of the original, Koons attempted to use fair use as his defense for his use of the copyrighted image. The Second Circuit rejected Koons' claim.

[96] See http://www.studiolo.org/IP/CTEA/Chris.htm.

organizations, library associations, archiving groups, writers' union, historians' association,[97] the effect of CTEA has been quickly felt. These groups engaging in artistic and cultural creation are deeply concerned that CTEA may be counter-productive in advancing the goal of the American copyright system: "to promote the progress of science and useful arts".

A few types of costs present themselves. One is transaction costs, which include fees paid to lawyers, accountants, bookkeepers to assist copyright transaction, litigation, record-tracing, and consulting incurred due to the 20 additional years added to copyright terms. The other is the cost due to the loss of future works that would have been created had copyright terms not been extended. Lobbying requires substantial resources and organization of affected parties and may or may not be a net cost to the economy.[98]

The large windfall of royalty fees that current copyright holders capture will be an internal transfer from consumers if we take the economy as a whole. Thus it does not constitute a welfare gain or loss to the economy.

There will be a productivity gain derived from added incentive. As we previously show, the present value of the total return from the extension is 0.33% of the present value of return from year one to eighty. The added incentive is small because of discounting of future values. This gain will last into the future, yet will be even smaller compared with the current one[99].

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[97] See http://cyber.law.harvard.edu/openlaw/eldredvashcroft/legal.html#amici.
[98] In the cases where lobbying provides relevant information to lawmakers, it may improve decision making by policymakers rather than merely transfer rents to the lobbying groups.
[99] In addition,, there might be a gain in equity from treating future and current copyright holders on an equitable basis.

Since all future costs and benefits are discounted and because of the time span of the CTEA, the resulting discounted future values are generally negligible compared with immediate gains and losses. Among the above costs, the transaction costs, loss of future works and lobbying cost are immediate costs to the economy, whereas the productivity gain is positive and immediate. The following figure may put the costs and benefits into better perspective, though some costs and benefits may be difficult to illustrate as will be discussed later.

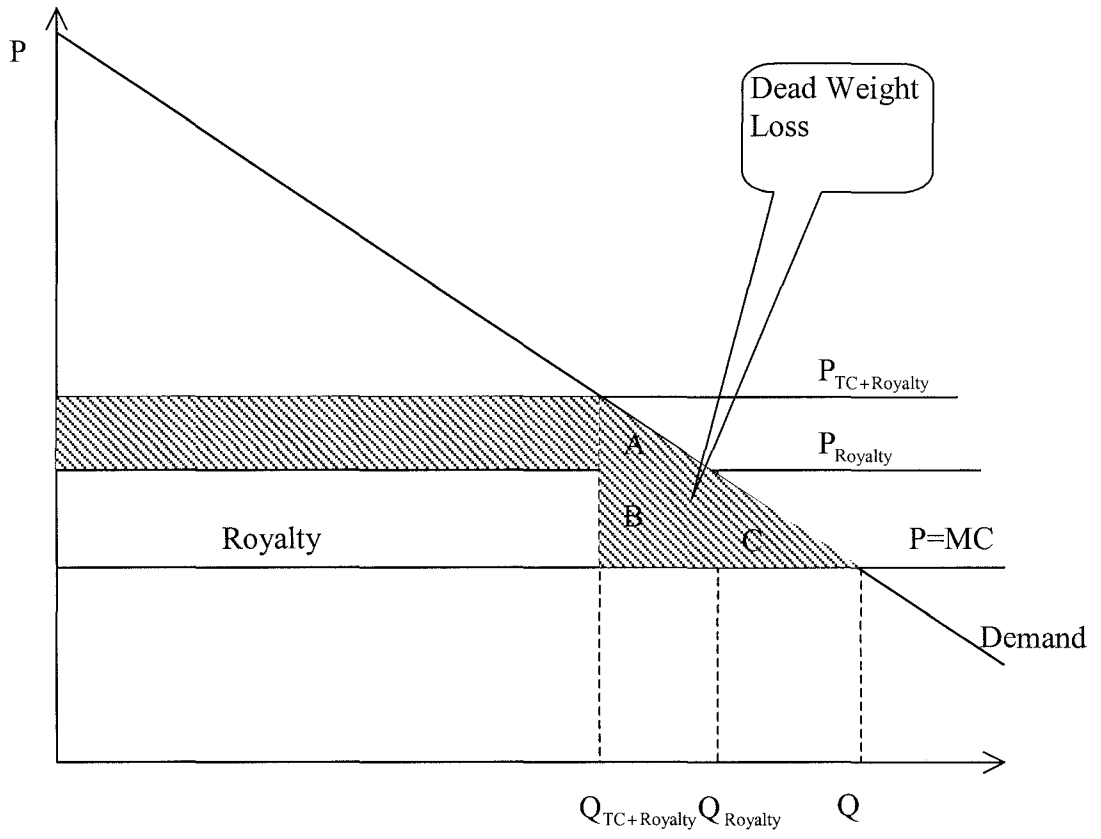

Figure 13 Costs of Copyright Term Extension4

Figure 3.3 illustrates the possible effect of a copyright term extension. Price, P, is equal to marginal cost MC when copyright expires. If the copyright does not expire, the price will be marginal cost plus the transaction cost and the royalty fee, thereby raising the price to $P_{TC+Royalty}$. The cost to the economy is – due to the higher price, consumer demand will decrease from Q to $Q_{TC+Royalty}$. The deadweight loss includes areas A, B, C and the transaction cost rectangle.The lobbying cost will be up to the royalty that the producers earn. The lobbying cost may or may not be part of deadweight loss depending on whether it provides relevant information or is pure rent-seeking.

Please note that the lobbying cost, the loss of new works due to increased costs of expression, and the potential productivity gain are not included in Figure 3-3. The loss of new works due to increased costs of expression is difficult to measure, and the productivity gain is negligible due to discounting of future values.

In short, the costs – transaction cost, loss of future works, lobbying cost, deadweight loss areas A, B, C – should be weighed against the benefits--the negligible productivity gain--to determine the overall welfare effects of CTEA. These measurements and comparison are beyond the current discussion and are left for future research.

VIII. Possibility of Further U.S. Extension and Globally Harmonized Copyright Term

Copyright in the United States has been extended periodically in the twentieth century. This naturally raises a concern about whether there will be another round of term extensions and what factors could inspire such changes.

As I argued above, most of the reasons proposed by CTEA advocates do not stand up well under close examination, such as the demographic change, harmonization with European Union and trade balance concerns. These arguments tend to be either weak in explaining why copyright extension is optimal or irrelevant from the economics perspective. The proponents for further extensions may raise these arguments again, but they are inherently weak. The technology argument is more germane than others. Conventional wisdom supports stronger protection of intellectual property rights as copying costs decline. However, the drawback is that it does not specify the dimensions through which copyright should become stronger: length or breadth? Therefore, it cannot inform public policy by indicating whether copyright protection should be broader or stronger. Recently, new studies have emerged to challenge the classic studies, and consequently there is no theoretical consensus on this issue. Additionally, after decades of "technological revolution", there may be little room for lower costs of copying and faster dissemination of information. Therefore, technology *per se* will not be able to make a strong argument for further extension as well.

I also suggested in the previous section that it is the retroactive application of the CTEA which galvanized big stake holders to intensively lobby the Congress. One can expect that prior to 2018, when many highly valued copyrights will have expired, these copyright holders are likely to rally to extend the copyright term. The outcome may, however, not be as predictable.

For one thing, academics are more aware of this trend towards continuous extension of copyright terms. Some economists were critical of CTEA, but scholars in other fields such as law, political science, and journalism attacked CTEA harshly. In fact a deluge of law articles criticizing CTEA appeared in law journals after 1998. Various other groups that are seriously affected by the term extension began to stand

up and voice their concerns. However, these are mostly writers, historians, archivists, professors whose ability to mobilize economic and political resources is much more limited than their opponents.

On the other hand, the resistance will remain strong as wealthy copyright holders are likely to spend significant resources on obtaining another round of extensions. Some associations of lawyers, e.g. the American Intellectual Property Law Association and the New York Intellectual Property Law Association are aligned with the large copyright holders.

The result of the future battle is far from certain, but the opponents have learned the hard lesson that the courts will be reluctant to reverse term extensions. Instead opponents are already focusing on persuading the U.S. Congress not to extend and on promoting awareness at the grassroots' level. We would expect to see a hard-fought battle a decade from now.

In the international arena, increasing copyright terms to the American-European levels will not be realized in the near future for the following reasons:

First, it was already difficult to convince many developing countries to adopt the minimum standard required by WTO and TRIPs. Jonathan Hepburn wrote that most "developing countries have long considered the TRIPS agreement to be unbalanced: it was negotiated in a way that failed to take account of their legitimate needs and concerns, and contains provisions and obligations which in many ways are entirely inappropriate to the development priorities of many of them."[100]

[100] See http://www.geneva.quno.info/pdf/OP10%20JH.pdf, p 10.

Second, developing countries may simply follow the logic of developed countries: Adopt extended copyright terms when the country becomes a net exporter of copyrighted goods and expects its trade balance to improve by increasing the term of protection.

Third, the United States and the European Union do not currently have a uniform copyright protection system. As I have shown, out of the 20 categories of copyright, only 2 have been harmonized. Since the United States and the European Union have the longest copyright terms, other regions have little incentive to harmonize until these two regions actually harmonize. Fourth, the developing countries have been slow to catch up with developed countries in establishing effective and independent judiciaries. Often, laws were hastily instituted under pressure from developed countries while enforcement lagged behind. Longer terms mean little when infringement is widespread.

IX. Conclusion

In this chapter, I reviewed the passage of Sonny Bono Copyright Extension Act (CTEA) in the broader context of American history of copyright term extension. In addition to presenting the legal battle, history and term structure of CTEA and the US copyright law, I combined economic, legal and historic approaches to analyzing the major arguments made by proponents for the passage of CTEA. In particular, I discussed in-depth rationales based on demographic changes and concerns on heirs' well being, harmonization with European Union, improving the trade balance, and responding to technological changes. I found that the first three arguments do not amount to strong reasons to extend the copyright term. Theoretical studies are split on whether technological change warrants stronger protection.

I maintain that retroactive application of CTEA--as a convention of copyright extension to achieve relative fairness–allowed the large soon-to-expire copyright holders to heavily lobby the congress to have it passed. I make a distinction between the immediate and the future costs and benefits to the economy attributed to CTEA. I suggest that the transaction cost, deadweight loss and lobbying cost, loss of future works and productivity gain are directly relevant to the analysis of CTEA's welfare impact. I also project that another copyright battle will be fought in the next decade and that global harmonization of copyright system in the near future is unlikely.

Table 2 Copyright Harmonization in Categories[101]

#	Nature of Work and Author	Pre-CTEA Term	Post-CTEA Term	Directive Term in EU	Harmonized?
1	Natural persons >1977	50 PMA	70 PMA	70 PMA	Yes
2	Natural persons <1978, works published 1950-1963	28;47	28;67	70 PMA	No
3	Natural persons <1978, works published 1964-1977	75	95	70 PMA	No
4	Natural persons <1978, works published <1950	75 (if still in renewal term on 1/1/78, the effective date of the 1976 Act)	95 (if still in renewal term on 10/27/98, effective date of the CTEA)	70 PMA	No
5	Joint Authors >1977	50 PMA (last surviving author)	70 PMA (last surviving author)	70 PMA (last surviving author)	Yes
6	Joint Authors <1978, works published 1950-1963	28;47	28:67	70 PMA (last surviving author)	No
7	Joint Authors <1978, works published 1964-1977	75	95	70 PMA (last surviving author)	No
8	Joint Authors <1978, works published <1950	75	95 (if still in renewal term on 10/27/98, effective date of the CTEA)	70 PMA (last surviving author)	No
9	Anonymous or Pseudonymous Authors >1977	Lesser of 75 from publication or 100 from creation	Lesser of 95 from publication or 120 from creation	70 from time made available to public (or 70 PMA if	No

[101] This table was compiled by Professor Dennis Karjala at the Arizona State University. See http://www.law.asu.edu/HomePages/Karjala/OpposingCopyrightExtension/legmats/HarmonizationChartDSK.html. Sources: Columns for Pre- and Post-CTEA Terms are taken from sections 302-304 of the Copyright Act: 17 U.S.C. §§ 302-304 prior to the CTEA, and §§ 302-304 as amended by the CTEA. The column "Directive Term in the EU" is based on the *Council Directive 93/98/EEC of 29 October 1993 harmonizing the term of protection of copyright and certain related rights*, 19 OJL 290. The "<" and ">" signs in the Chart mean "before" and "after," respectively. Thus, for example, ">1977" means "after 1977" (or "1978 and beyond"). Also "PMA" is short for "post mortem auctoris," or past the death of the author. Thus, 70 PMA means the term lasts for 70 years after the death of the author.

				author's name becomes known within 70)	
10	Works made for hire >1977	Lesser of 75 from publication or 100 from creation	Lesser of 95 from publication or 120 from creation	70 PMA (70 if individual author not identified in released version)	No
11	Works made for hire <1978 (same as 2, 3, & 4 above)	28;47 (1950-1963) 75 (1964-1977) 75 (<1950)	28;67 (1950-1963) 95 (1964-1977) 95 (<1950)	70 PMA (70 if individual author not identified in released version)	No
12	Audiovisual works >1977, created as works made for hire	Lesser of 75 from publication or 100 from creation	Lesser of 95 from publication or 120 from creation	70 PMA of principal director, screenplay author, dialogue author, or composer	No
13	Audiovisual works <1978, created as works made for hire	28;47 (1950-1963) 75 (1964-1977) 75 (<1950)(if in renewal term on 1/1/78)	28;67 (1950-1963) 95 (1964-1977) 95 (<1950)(if in renewal term on 10/27/98)	70 PMA of principal director, screenplay author, dialogue author, or composer	No
14	Film Producers	No rights under copyright unless authors or assignees of authors	No rights under copyright unless authors or assignees of authors	"Related rights" expire at sooner of 50 years from first publication or first communication to public	No
15	Broadcasting Organizations	No rights under copyright unless authors or assignees of authors	No rights under copyright unless authors or assignees of authors	"Related rights" expire 50 years after transmission	No
16	Sound Recordings >1977	75 or 50 PMA, depending on nature of author	95 or 70 PMA, depending on nature of author	"Related rights" expire 50 years from sooner of first publication or first communication to public	No
17	Sound Recordings 1972-1977	75	95	"Related rights" expire 50 years from sooner of first publication or first communication to public	No

18	Sound Recordings <1972	State law until 2047	State law until 2067	"Related rights" expire 50 years from sooner of first publication or first communication to public	No
19	Unpublished works on which copyright has expired	0	0	25 from publication	No
20	Unpublished works <1978 not previously copyrighted or in the public domain	Greater of 50 PMA or until 2003; if published before 2003, greater of 50 PMA or until 2028	Greater of 70 PMA or until 2003; if published before 2003, greater of 70 PMA or until 2048	70 PMA	Partially (harmonized for relatively recent works, not for older works)

Table 3 Estimated Life Expectancy

Table 12. Estimated life expectancy at birth in years, by race and sex: Death-registration States, 1900–28, and United States, 1929–97

[For selected years, life table values shown are estimates; see Technical notes. Beginning 1970 excludes deaths of nonresidents of the United States; see Technical notes]

Area and year	All races			White			Black[4]		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
United States[1]									
1997	76.5	73.6	79.4	77.2	74.3	79.9	71.1	67.2	74.7
1996	76.1	73.1	79.1	76.8	73.9	79.7	70.2	66.1	74.2
1995	75.8	72.5	78.9	76.5	73.4	79.6	69.6	65.2	73.9
1994	75.7	72.4	79.0	76.5	73.3	79.6	69.5	64.9	73.9
1993	75.5	72.2	78.8	76.3	73.1	79.5	69.2	64.6	73.7
1992	75.8	72.3	79.1	76.5	73.2	79.8	69.6	65.0	73.9
1991	75.5	72.0	78.9	76.3	72.9	79.6	69.3	64.6	73.8
1990	75.4	71.8	78.8	76.1	72.7	79.4	69.1	64.5	73.6
1989	75.1	71.7	78.5	75.9	72.5	79.2	68.8	64.3	73.3
1988	74.9	71.4	78.3	75.6	72.2	78.9	68.9	64.4	73.2
1987	74.9	71.4	78.3	75.6	72.1	78.9	69.1	64.7	73.4
1986	74.7	71.2	78.2	75.4	71.9	78.8	69.1	64.8	73.4
1985	74.7	71.1	78.2	75.3	71.8	78.7	69.3	65.0	73.4
1984	74.7	71.1	78.2	75.3	71.8	78.7	69.5	65.3	73.6
1983	74.6	71.0	78.1	75.2	71.6	78.7	69.4	65.2	73.5
1982	74.5	70.8	78.1	75.1	71.5	78.7	69.4	65.1	73.6
1981	74.1	70.4	77.8	74.8	71.1	78.4	68.9	64.5	73.2
1980	73.7	70.0	77.4	74.4	70.7	78.1	68.1	63.8	72.5
1979	73.9	70.0	77.9	74.6	70.8	78.4	68.5	64.0	72.9
1978	73.5	69.6	77.3	74.1	70.4	78.0	68.1	63.7	72.4
1977	73.3	69.5	77.2	74.0	70.2	77.9	67.7	63.4	72.0
1976	72.9	69.1	76.8	73.6	69.9	77.5	67.2	62.9	71.6
1975	72.6	68.8	76.6	73.4	69.5	77.3	66.8	62.4	71.3
1974	72.0	68.2	75.9	72.8	69.0	76.7	66.0	61.7	70.3
1973	71.4	67.6	75.3	72.2	68.5	76.1	65.0	60.9	69.3
1972[2]	71.2	67.4	75.1	72.0	68.3	75.9	64.7	60.4	68.1
1971	71.1	67.4	75.0	72.0	68.3	75.8	64.6	60.5	68.9
1970	70.8	67.1	74.7	71.7	68.0	75.6	64.1	60.0	68.3
1969	70.5	66.8	74.4	71.4	67.7	75.3	64.5	60.6	68.6
1968	70.2	66.6	74.1	71.1	67.5	75.0	64.1	60.4	67.9
1967	70.5	67.0	74.3	71.4	67.8	75.2	64.9	61.4	68.5
1966	70.2	66.7	73.9	71.1	67.5	74.8	64.2	60.9	67.6
1965	70.2	66.8	73.8	71.1	67.6	74.8	64.3	61.2	67.6
1964	70.2	66.8	73.7	71.0	67.7	74.7	64.2	61.3	67.3
1963[3]	69.9	66.6	73.4	70.8	67.4	74.4	63.7	61.0	66.6
1962[3]	70.1	66.9	73.5	70.9	67.1	74.5	64.2	61.6	66.9
1961	70.2	67.1	73.6	71.0	67.8	74.6	64.5	62.0	67.1
1960	69.7	66.6	73.1	70.6	67.4	74.1	63.6	61.1	66.3
1959	69.9	66.8	73.2	70.7	67.5	74.2	63.9	61.3	66.5
1958	69.6	66.6	72.9	70.5	67.4	73.9	63.4	61.0	65.8
1957	69.5	66.4	72.7	70.3	67.2	73.7	63.0	60.7	65.5
1956	69.7	66.7	72.9	70.5	67.5	73.9	63.6	61.3	66.1
1955	69.6	66.7	72.8	70.5	67.4	73.7	63.7	61.4	66.1
1954	69.6	66.7	72.8	70.5	67.5	73.7	63.4	61.1	65.9
1953	68.8	66.0	72.0	69.7	66.8	73.0	62.0	59.7	64.5
1952	68.6	65.8	71.6	69.5	66.6	72.6	61.4	59.1	63.8
1951	68.4	65.6	71.4	69.3	66.5	72.4	61.2	59.2	63.4
1950	68.2	65.6	71.1	69.1	66.5	72.2	60.8	59.1	62.9
1949	68.0	65.2	70.7	68.8	66.2	71.9	60.6	58.9	62.7
1948	67.2	64.6	69.9	68.0	65.5	71.0	60.0	58.1	62.5
1947	66.8	64.4	69.7	67.6	65.2	70.5	59.7	57.9	61.9
1946	66.7	64.4	69.4	67.5	65.1	70.3	59.1	57.5	61.0
1945	65.9	63.6	67.9	66.8	64.4	69.5	57.7	56.1	59.6
1944	65.2	63.6	66.8	66.2	64.5	68.4	56.6	55.8	57.7
1943	63.3	62.4	64.4	64.2	63.2	65.7	55.6	55.4	56.1
1942	66.2	64.7	67.9	67.3	65.9	69.4	56.6	55.4	58.2
1941	64.8	63.1	66.8	66.2	64.4	68.5	53.8	52.5	55.3
1940	62.9	60.8	65.2	64.2	62.1	66.6	53.1	51.5	54.9
1939	63.7	62.1	65.4	64.9	63.3	66.6	54.5	53.2	56.0
1938	63.5	61.9	65.3	65.0	63.2	66.8	52.9	51.7	54.3
1937	60.0	58.0	62.4	61.4	59.3	63.8	50.3	48.3	52.5
1936	58.5	56.6	60.6	59.8	58.0	61.9	49.0	47.0	51.4
1935	61.7	59.9	63.9	62.9	61.0	65.0	53.1	51.3	55.2

See footnotes at end of table.

Table 12. Estimated life expectancy at birth in years, by race and sex: Death-registration States, 1900–28, and United States, 1929–97—Con.

[For selected years, life table values shown are estimates; see Technical notes. Beginning 1970 excludes deaths of nonresidents of the United States; see Technical notes]

Area and year	All races			White			Black[4]		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
United States—Con.									
1934	61.1	59.3	63.3	62.4	60.5	64.6	51.8	50.2	53.7
1933	63.3	61.7	65.1	64.3	62.7	66.3	54.7	53.5	56.0
1932	62.1	61.0	63.5	63.2	62.0	64.5	53.7	52.8	54.6
1931	61.1	59.4	63.1	62.6	60.8	64.7	50.4	49.5	51.5
1930	59.7	58.1	61.6	61.4	59.7	63.5	48.1	47.3	49.2
1929	57.1	55.8	58.7	58.6	57.2	60.3	46.7	45.7	47.8
Death-registration States									
1928	56.8	55.6	58.3	58.4	57.0	60.0	46.3	45.6	47.0
1927	60.4	59.0	62.1	62.0	60.5	63.9	48.2	47.6	48.9
1926	56.7	55.5	58.0	58.2	57.0	59.6	44.6	43.7	45.6
1925	59.0	57.6	60.6	60.7	59.3	62.4	45.7	44.9	46.7
1924	59.7	58.1	61.5	61.4	59.8	63.4	46.6	45.5	47.8
1923	57.2	56.1	58.5	58.3	57.1	59.6	48.3	47.7	48.9
1922	59.6	58.4	61.0	60.4	59.1	61.9	52.4	51.6	53.0
1921	60.8	60.0	61.8	61.8	60.8	62.9	51.5	51.6	51.3
1920	54.1	53.6	54.6	54.9	54.4	55.6	45.3	45.5	45.2
1919	54.7	53.5	56.0	55.8	54.5	57.4	44.5	44.5	44.4
1918	39.1	36.6	42.2	39.8	37.1	43.2	31.7	29.9	32.5
1917	50.9	48.4	54.0	52.0	49.3	55.3	38.8	37.0	40.8
1916	51.7	49.6	54.3	52.5	50.2	55.2	41.3	39.6	43.1
1915	54.5	52.5	56.8	55.1	53.1	57.5	36.9	37.5	40.5
1914	54.2	52.0	56.8	54.9	52.7	57.5	38.9	37.1	40.8
1913	52.5	50.3	55.0	53.0	50.8	55.7	38.4	36.7	40.3
1912	53.6	51.5	55.9	53.9	51.8	56.2	37.0	35.9	40.0
1911	52.6	50.9	54.4	53.0	51.3	54.9	36.4	34.6	38.2
1910	50.0	48.4	51.8	50.3	48.6	52.0	35.6	33.8	37.5
1909	52.1	50.5	53.8	52.5	50.9	54.2	35.7	34.2	37.3
1908	51.1	49.5	52.8	51.5	49.9	53.3	34.9	33.8	36.0
1907	47.6	45.6	49.9	48.1	46.0	50.4	32.5	31.1	34.0
1906	48.7	46.9	50.8	49.3	47.3	51.4	32.9	31.8	33.9
1905	48.7	47.3	50.2	49.1	47.6	50.6	31.3	29.6	33.1
1904	47.6	46.2	49.1	48.0	46.6	49.5	30.8	29.1	32.7
1903	50.5	48.1	52.0	50.9	49.5	52.5	33.1	31.7	34.6
1902	51.5	49.8	53.4	51.9	50.2	53.8	34.6	32.9	36.4
1901	49.1	47.6	50.6	49.4	48.0	51.0	33.7	32.2	35.3
1900	47.3	46.3	48.3	47.6	46.6	48.7	33.0	32.5	33.5

[1]Alaska included in 1959 and Hawaii in 1960.
[2]Deaths based on a 50-percent sample.
[3]Figures by race exclude data for residents of New Jersey; see Technical notes.
[4]Prior to 1970, data for the black population are not available. Data shown for 1900–68 are for the nonwhite population. See Technical notes.

Appendix I

I focus on the issue of comparison of a fixed term versus an uncertain life term. A simple model with two cases is analyzed. In the first case, a risk-neutral agent receives an income stream for a fixed period of time 1. There is no uncertainty. For simplicity, I assume the time period is 1. In the second case, the agent faces a life expectancy of 1. However, he could die at any time. In both cases the discount rate r is positive.

Case I: No Uncertainty

$$
\begin{aligned}
& Expected(income) - Cost \\
&= \int_0^1 P * Qe^{-rt} dt - Cost \\
&= \frac{P * Q(1-e^{-rt})}{r}\Big|_0^1 - Cost \\
&= \frac{P * Q(1-e^{-r})}{r} - Cost \qquad (1)
\end{aligned}
$$

where $P * Q$ is the income at any point in time. The author's total income is equal to expected income less cost.

Case II: Uncertainty

$$
\begin{aligned}
& Expected(income) - Cost \\
&= \int_0^\infty (UT) f(UT) d(UT) - Cost \\
&= \int_0^\infty (UT) f(UT) d(UT) - Cost \\
&= \int_0^\infty (UT)((1-\frac{UTr}{PQ})^{(\frac{1}{r}-1)} \cdot \frac{1}{PQ}) d(UT) - Cost \\
&= \frac{(\frac{UTr-PQ}{PQ})^{\frac{r-1}{r}}(-P^2Q^2 + rUT^2 - (UT)PQ + (UT)PQr)}{PQ(1+r)}\Big|_0^\infty - Cost \quad where \lim_{UT\to\infty} UT = \frac{PQ}{r} \\
&= \frac{PQ}{1+r} - Cost \qquad (2)
\end{aligned}
$$

UT is equal to instantaneous income, $P * Q$, times T, longevity, which is a stochastic variable in Case II. $f(UT)$ is the density function of UT, which is derived in Sub-Appendix I.

Conclusions:

Comparing equation (1) and (2) where discount rate r is positive, $\frac{PQ(1-e^{-r})}{r} > \frac{PQ}{1+r}$ (proof in the Sub-Appendix II) which implies that **the fixed-term protection will generate higher income than a life-related term**, when the expected longevity is equal to the fixed term. This holds true when the author is risk-neutral. Presumably the utility is even lower with a life-related term if the author is risk-averse.

Sub-Appendix I:

$$f(T) = e^{-T}$$

where $f(T)$ is the survival function or the probability density function of longevity. Integrating the function from 0 to T yields the expected longevity of the author, which is 1 here in order to be comparable with the first case.

$$UT = P * Q * T$$

$$T = h(UT) = \frac{UT}{P * Q}$$

$$\frac{dT}{dUT} = \frac{1}{P * Q}$$

$$f(UT) = f(h(UT))\left|\frac{dT}{dUT}\right|$$

$$= e^{-\frac{UT}{P*Q}}\left(\frac{1}{P * Q}\right)$$

$$\textit{to verify it is probability density function, } \int_0^\infty f(UT)dUT = 1$$

The derivation of $f(UT)$ follows similar steps.

Sub-Appendix II:

Comparing $\frac{PQ(1-e^{-r})}{r}$ with $\frac{PQ}{1+r}$.

Suppose $\frac{PQ}{1+r} > \frac{PQ(1-e^{-r})}{r}$

therefore, $\frac{1}{1+r} > \frac{(1-e^{-r})}{r}$

therefore, $\frac{r}{1+r} > (1-e^{-r})$

therefore, $e^{-r} > 1 - \frac{r}{1+r}$

$e^{-r} > \frac{1}{1+r}$

$\frac{1+r}{e^{r}} > 1$

$(1+r) > e^{r}$ which apparently does not hold.

Therefore, $\frac{PQ(1-e^{-r})}{r} > \frac{PQ}{1+r}$

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