Exploring a better design of copyright law

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Abstract

This study proposes a simulation model aimed at exploring how copyright law should be designed; that is, a desirable combination of copyright length and breadth. The model incorporates several specific properties of creative industries but is hard to deal with analytically because of its dynamic feature. Changes in social welfare under different copyright designs are examined using numerical simulation. The simulation results reveal that a short and narrow copyright is the best, whereas a long and broad copyright is the least best. Moreover, length impacts the growth of social welfare, and breadth impacts its level. Thus, in the long run, short length can be more important than narrow breadth for social welfare.

Keywords: Creative industries, Copyright length, Copyright breadth, Numerical simulation

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1 Introduction

People are discontented with the current copyright law, and disagreement between rights holders and users has been growing. A recent example of such disagreement was seen in the Trans-Pacific Partnership (TPP) negotiations. Under the influence of large rights-holding companies, negotiators proposed to extend copyright terms by 20 years beyond the minimum 50-year copyright term in the 1994 agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). Many non-government groups, including Creative Commons, opposed it.[1]

Several economists have attempted to mitigate this situation by analyzing the optimal level of copyright protection, focusing either on its length or its breadth. Length is the term of copyright protection, and breadth is the amount of a protected work that can be freely used or copied by non-rights holders (e.g., fair use). Theoretical studies on optimal copyright length include those by Yuan (2005), Pollock (2009), and Adilov and Waldman (2012). Studies on optimal copyright breadth include those by Novos and Waldman (1984), Landes and Posner (1989), Yoon (2002), and Miceli and Adelstein (2006).[2] Unlike for the patent design literature, both length and breadth for copyright law have not yet been explored.[3]

Furthermore, most literature on optimal copyright protection focuses on the effect of a policy change on a creator's revenue from a work, which is the incentive to create a new work. The exception is the model of Landes and Posner (1989), which states that a change in copyright protection level affects the cost of creating new works (the "expression cost") as well as a creator's revenue. While strengthening copyright protection increases a creator's monopolistic profit from selling copies of a work, it can also increase the expression cost because past works are important inputs for creating new works.

[1]Creative Commons Blog News, "An Open Letter to TPP Negotiators: Copyright Term Extension Makes No Sense," Ryan Merkley, July 9th, 2014 (http://creativecommons.org/weblog/entry/43256, last accessed on May 20th, 2016).

[2]Landes and Posner (1989) explain that the copyright protection level in their model can include the length of copyright term. Their model, however, is static, where the dynamic process of creators' behavior is ignored.

[3]For the literature on optimal patent design, see the survey by Rockett (2010).

This study attempts to integrate these issues and provides a theoretical framework to examine the optimal combination of copyright length and breadth. The model incorporates several characteristics from the model of Landes and Posner (1989), including the idea of expression cost, and specific properties of creative industries (e.g., books, records, and films), including the *infinite variety* and *nobody knows* properties (Caves, 2000). Because of the *infinite variety* property, old creative works are not replaced by new ones and both old and new works coexist in different markets in the model. The *nobody knows* property indicates that great uncertainty exists about how consumers will value a new creative work. Based on this property, the model is constructed as a series of static problems where a creator maximizes short-run profit in each period. This feature of the model differs from that in previous studies of the optimal design of intellectual property rights, where the monopolist maximizes the discounted sum of all future profits. Other important features of theoretical models in the previous studies of the optimal copyright law design are omitted for simplicity, such as investment in the quality of a work (Novos and Waldman, 1984; Adilov and Waldman, 2012).

The model, in spite of its simplicity, is hard to deal with analytically because it specifies that the expression cost varies stochastically and dynamically depending on the number of successful works and their protection status. Thus, changes in social welfare under different copyright designs are examined using numerical simulation.[4] The simulation results reveal that a short and narrow copyright is the best, whereas a long and broad copyright is the least best. The results are robust with regard to different levels of expression cost, but the difference between a short narrow copyright and a long broad copyright is larger when the expression cost is lower. Moreover, in the long run, short copyright can be more important than narrow copyright for social welfare because length affects its growth and breadth affects its level.

The rest of the paper proceeds as follows. Section 2 explains the model. Section 3 presents the results of the numerical analysis. Section 4 concludes the study.

[4] A similar approach is taken by Muller and Pénin (2006), who use a simulation model to describe the dynamics of innovation networks and the role of open knowledge disclosure.

2 Model

2.1 Basic assumptions

In each period denoted by t, there are N_t creators of works, such as books, music, or films. As in the model of Landes and Posner (1989), a creator is not distinguished from a publisher, recording company, or film company. Both the marginal and fixed costs of making and distributing copies (or reproductions) are set to zero, and creators incur only the cost of creating new works, that is, the expression cost.

Each creator i decides the number of new works produced at the beginning of each period t, which is denoted as K_{it}. The period of a new work's publication is denoted by p, and the term of copyright protection (copyright length) is denoted by T_c. During the copyright term ($t - p \leq T_c$), a work's creator is the only provider of copies of the work and its derivative works. As in the model of Landes and Posner (1989), all different ways to exploit a work are treated identically and are called "providing copies," which include different media (e.g., CD, MP3, and music streaming), licensing, and derivative works. Moreover, each work is sufficiently differentiated, and the market for copies of a work is independent. This feature of creative product is called the *infinite variety* property by Caves (2000), who explains that two songs, two paintings, or two movies may be quite similar but are not identical.

Let v_{ikpt} be period t's market value of creator i's k-th work published in period p ($\leq t$), defined as the sum of all consumers' willingness to pay for copies of that work during period t. Since the marginal cost of providing copies is zero, v_{ikpt} equals the consumer surplus at the competitive price. Before a work is published, its market value v_{ikpt} is unknown and is defined as the following stochastic variable.

$$v_{ikpt} = \begin{cases} (1-\delta)^{t-p} v & \text{with probability} \quad \rho \\ 0 & \text{with probability} \quad 1-\rho, \end{cases}$$

where $0 < \delta < 1$, $0 < \rho < 1$, and $v > 0$. The value of a work at the period of publication ($t = p$) is v or 0 for any work. If a work's initial value is v, it depreciates at the rate of δ every period. A work with non-zero value is called a "longtime seller." Such simplification of a work's value is based on the well-known fact that the great majority of copyrighted works never have much market value and that a small percentage of titles constitutes a large share of the sales of copyrighted materials (Liebowitz and Margolis, 2005).[5] The success probability ρ, which would be very low because of the above fact, is exogenously given based on the *nobody knows* property: the risk associated with any given creative product is high, and no signal has any statistical ability to predict which product will succeed (Caves, 2000).

In addition to copyright length T_c, copyright breadth z is another parameter that controls copyright protection. The breadth parameter $0 < z < 1$ determines the extent of a work's market value that its creator can take. For a copyright-protected work with a value $v_{ikpt} > 0$, consumers pay only for zv_{ikpt} of the copies because $(1-z)v_{ikpt}$ of the copies is freely available to them. Limitations on copyright, such as the fair use doctrine, make z less than 1, and z decreases as the copyright limitation is extended. Then, during the copyright term, a creator's gross profit from a work in a period is $\alpha z v_{ikpt}$, and consumer surplus is $\beta z v_{ikpt} + (1-z)v_{ikpt}$, where $\alpha, \beta > 0$ and $\alpha + \beta < 1$. $(1-\alpha-\beta)zv_{ikpt}$ equals dead weight loss during the copyright term. After the copyright expires, all the value of v_{ikpt} goes to consumers.

2.2 Dynamics of the model

Creators start publishing new works from $t = 1$, possessing no proprietary works at the beginning of the initial period. A creator i's total profit during a period after publishing new works is given as follows: for $t = 1$,

$$\pi_{i1} = \alpha z \sum_{k=1}^{K_{i1}} v_{ik11} - e(K_{i1}),$$

and for $t \geq 2$,

$$\pi_{it} = \alpha z \left(\sum_{k=1}^{K_{it}} v_{iktt} + \sum_{p=1}^{t-1} \sum_{k=1}^{K_{ip}} 1[t-p \leq T_c] v_{ikpt} \right) - e(K_{it}),$$

where $1[t-p \leq T_c]$ is the indicator function taking 1 if $t - p \leq T_c$ and 0

[5] Liebowitz and Margolis (2005) also demonstrate that the longevity of best-selling books is quite long (more than 85 years) based on sample titles reviewed in *Book Review Digest* in the 1920s.

otherwise, and $e(K_{it})$ is creator i's cost of creating K_{it} new works in period t (the expression cost), with $e'(K_{it}) > 0$ and $e''(K_{it}) > 0$.

The expression cost $e(K_{it})$, which creator i has to bear before publication, is affected by the stock of past works: it decreases when the larger part of the stock is freely available. The values of past works that are used as inputs of new works at the beginning of period $t \geq 2$ are categorized into the following three types:

(1) creator i's own proprietary works

$$C_{it}^{OP} \equiv \sum_{p=1}^{t-1} \sum_{k=1}^{K_{ip}} 1[t - p \leq T_c] v_{ikpt},$$

(2) all creators' proprietary works

$$C_t^{AP} \equiv \sum_{p=1}^{t-1} \sum_{i=1}^{N_p} \sum_{k=1}^{K_{ip}} 1[t - p \leq T_c] v_{ikpt},$$

and (3) public domain works

$$C_t^{PD} \equiv \sum_{p=1}^{t-1} \sum_{i=1}^{N_p} \sum_{k=1}^{K_{ip}} 1[t - p > T_c] v_{ikpt} + (1-\delta)^t C_0^{PD},$$

where $C_0^{PD} > 0$ is the value of public domain works that exist before the initial period, which is given exogenously. Then, the expression cost is specified as the following: for $t = 1$,

$$e(K_{i1}) = \theta \left\{ \frac{1}{(1-\delta)C_0^{PD}} \right\} K_{i1}^2,$$

and for $t \geq 2$,

$$e(K_{it}) = \theta \left\{ \frac{1 + z\left(C_t^{AP} - C_{it}^{OP}\right)}{C_t^{PD} + zC_{it}^{OP} + (1-z)\left(C_t^{AP} - C_{it}^{OP}\right)} \right\} K_{it}^2,$$

where $\theta > 0$. A creator i's expression cost decreases when the extent of freely available past works increases. Moreover, the expression cost varies by creator. Creators possessing a large number of longtime seller have cost advantages over other creators.

The effects of changes in copyright length and breadth on the expression cost also vary by creator. For example, the effect of a change in breadth z on creator i's expression cost ($t \geq 2$),

$$\frac{\partial e(K_{it})}{\partial z} = \theta \left[\frac{C_t^{PD}\left(C_t^{AP} - C_{it}^{OP}\right) + \left(C_t^{AP} - C_{it}^{OP}\right)^2 + C_t^{AP} - 2C_{it}^{OP}}{\left\{C_t^{PD} + zC_{it}^{OP} + (1-z)\left(C_t^{AP} - C_{it}^{OP}\right)\right\}^2} \right] K_{it}^2,$$

is positive when, for example, $C_t^{AP} > 2C_{it}^{OP}$ and negative when, for example, $C_t^{AP} = C_{it}^{OP}$. The parameter θ plays an important role in determining the extent of the effects of changes in copyright length and breadth. Landes and Posner (1989) predict that if the derivative of the expression cost with respect to copyright breadth is larger, which is assumed to be positive, the optimal level of protection will be lower. In the following analysis, the effects of changes in protection levels are examined under different levels of θ.

In each period t, after the values of new works and creators' profits are determined, a (real-world) constraint is placed on creators: each creator's total profit accumulated from the initial period, $\sum_{s=1}^{t} \pi_{is}$, where the interest rate is set to zero for simplicity, must remain non-negative. Otherwise, a creator is considered to be bankrupt. Such a creator, whose accumulated profit becomes negative in period t, exits from the market, stops publishing new works, and no longer provides copies of all past proprietary works after t. Furthermore, it is assumed that an exiting creator neither transfers copyrights of all proprietary works to other creators nor donates the copyrighted works to the public domain. Although copies of bankrupt creators' works are not provided to consumers during their copyright terms, those works affect the expression cost until their copyrights expire. Thus, in calculating the expression cost $e(K_{it})$ in period t, the number of creators N_p includes all the creators who exited by the end of period p ($\leq t-1$). This assumption is for simplicity, but it imitates the "orphan works" problem in the real world.[6] Even during the copyright term, $(1 - z)$ of those orphan works' values are available to creators and consumers, and they become fully available after their copyrights expire.

Based on the above assumptions, a creator's decision problem is formulated as a series of the following static optimizations: creator i determines the number of new works to be produced at the beginning of period t, maximizing the expected profit from new works during *that* period. Creators in this study are

[6]For the problem of orphan works, see, for example, a report by the US copyright office "Orphan Works and Mass Digitization: A Report of the Register of Copyrights in June 2015" (available on http://www.copyright.gov/orphan/, last accessed on May 20th, 2016). In the report, an orphan work is defined as any original work of authorship for which a good faith prospective user cannot readily identify and/or locate the copyright owner(s) in a situation where permission from the copyright owner(s) is necessary as a matter of law.

assumed to evaluate the investment return only by a single period's expected revenue because of the *nobody knows* property and exit condition. Since many new works can have zero value and the expression cost is determined by the number of works, regardless of their success or failure, producing a large number of new works in anticipation of all future revenues raises the risk of negative profit and exit. For example, at $\rho = 0.2$, the probability that the number of successes is less than the mean is 0.376 for $K_{it} = 10$ and 0.482 for $K_{it} = 500$.[7] Evaluating the investment return only by single-period revenue and producing a relatively small number of new works mitigate the risk of going bankrupt.

In the literature of the optimal design of intellectual property rights, the conventional assumption is that the term impacts the monopolist's investment through the future profits. A longer term increases the discounted sum of future profits and induces more investment. In this study's model, on the other hand, the term impacts a creator's publications through the expression cost and the possibility of exit. For a longer copyright term, a creator possessing many valuable proprietary works would keep having a cost advantage and would stay longer in the market.

A creator i's total profit from K_{it} new works during a period t expected at the beginning of the period (before publication) is

$$\begin{aligned} E[\pi_{it}^{new}(K_{it})] &= \alpha z E\left[\sum_{k=1}^{K_{it}} v_{iktt}\right] - e(K_{it}) \\ &= \alpha z \rho K_{it} v - e(K_{it}). \end{aligned}$$

Let $\tilde{K}_{it}$ be the number of creator i's new works in period t that is defined as a real number. Following the above argument, in each period t, creator i solves

$$\max_{\tilde{K}_{it}} E[\pi_{it}^{new}(\tilde{K}_{it})].$$

The solution $\tilde{K}_{it}^*$ is given for $t = 1$,

$$\tilde{K}_{i1}^* = \frac{\alpha z \rho v}{2\theta} \left\{ \frac{1}{(1-\delta) C_0^{PD}} \right\}^{-1},$$

[7] In the numerical simulation below, when the discounted sum of future expected revenues is used, instead of a single period's expected revenue, no creator survived the first period.

and for $t \geq 2$,

$$\tilde{K}_{it}^{*} = \frac{\alpha z \rho v}{2\theta} \left\{ \frac{1 + z\left(C_t^{AP} - C_t^{OP}\right)}{C_t^{PD} + zC_{it}^{OP} + (1-z)\left(C_t^{AP} - C_{it}^{OP}\right)} \right\}^{-1}.$$

Then, the optimal number of creator i's new works in period t, K_{it}^{*}, is defined as the smallest integer larger than or equal to $\tilde{K}_{it}^{*}$, i.e., $K_{it}^{*} \equiv \lceil \tilde{K}_{it}^{*} \rceil$. After publishing K_{it}^{*} new works, the profit π_{it} is determined. As noted above, if $\sum_{s=1}^{t} \pi_{is} < 0$, creator i stops creating new works and also stops providing copies of all proprietary works from the period $t+1$.

In addition to the exit of creators, the model also incorporates new entries. The number of new creators who enter in period $t+1$ is assumed to be a stochastic variable whose mean depends on the value of the stock of freely available past works. The distribution of new entries in $t+1$ is specified as a Poisson distribution whose mean is given as $\lambda \ln \left\{(1-z)C_t^{AP} + C_t^{PD}\right\}$, where $\lambda > 0$.

Finally, the desirability of different copyright designs is compared on the basis of social welfare in a period t, w_t. It is defined as the sum of creators' total profits from all protected works and consumers' surpluses from all available works minus the costs of creating new works in that period. Let $j = 1, ..., \tilde{N}_t$ denote the creators who survived in $t-1$ plus new entries in t (i denotes all the creators including bankrupts). Then, w_t is defined as

$$\begin{aligned} w_t = &\sum_{p=1}^{t} \sum_{j=1}^{\tilde{N}_t} \sum_{k=1}^{K_{jp}} 1[t-p \leq T_c](\alpha+\beta) z v_{jkpt} \\ &+ \sum_{p=1}^{t} \sum_{i=1}^{N_p} \sum_{k=1}^{K_{ip}} \{1[t-p \leq T_c](1-z) v_{ikpt} + 1[t-p > T_c] v_{ikpt}\} \\ &- \sum_{j=1}^{\tilde{N}_t} e(K_{jt}), \end{aligned}$$

where the first, second, and third lines correspond to the total surplus of all the commercially available proprietary works, consumers' surplus of the freely available part of all protected works and the public domain works, and the cost of creating new works in period t, respectively.

2.3 Settings for numerical analysis

Although creators solve static problems in every period, their expression costs vary stochastically over time depending on the number of longtime seller successfully produced by each creator and whether these works are protected, which is determined by their publication periods and copyright terms. The model is hard to deal with analytically because time, that is, "when" creators optimize, affects their decision making.[8] Therefore, the effects of changes in the two copyright design parameters z and T_c on the sequence of social welfare w_t are examined using numerical simulation.

Each simulation runs for 200 periods ($t = 1$ to 200) and is repeated 100 times. For each of the two copyright policy parameters, z and T_c, three values are given, and thus nine different designs are examined. Moreover, as explained above, these nine copyright designs are examined under two different values of θ, the expression cost parameter that determines sensitivity to policy changes. The values of parameters z, T_c, and θ are shown in Table 1, and other simulation parameters are shown in Table 2.[9]

Table 1: Set of policy changes and cost parameters

Parameter	Values
z (breadth)	0.2, 0.5, 0.8
T_c (length)	50, 100, 150
θ (cost parameter)	0.02, 0.2

[8] Therefore, the model does not satisfy stationarity, which is vital to the dynamic programming approach.

[9] The parameters for creator and consumer surpluses, α and β, are determined by the assumption that the demand curve is linear. Let the demand function for a work's copies be $p_c = a - bx$, where p_c is the price and x is the quantity. Then, the creator's (monopolist's) profit is $\frac{a^2}{4b}$, consumers' surplus is $\frac{a^2}{8b}$, and the dead weight loss is $\frac{a^2}{8b}$.

Table 2: Simulation parameters

Parameter	Definition	Value
α	Ratio of creator's profit to a work's value	0.5
β	Ratio of consumer surplus to a work's value	0.25
δ	Obsolescence rate of longtime seller	0.01
ρ	Success probability that a work is longtime seller	0.2
λ	Parameter for new entry	0.005
N_1	Number of creators in the initial period	5
C_0^{PD}	Value of public domain works before the initial period	10
v	The initial value of longtime seller	10

3 Simulation results

First, to briefly compare the performance of each copyright design, the values of social welfare w_t over 200 periods are simply added for each simulation run ("total social welfare" in the following), and the average of 100 simulation runs is taken for each copyright design, which is denoted by the vector (z, T_c). In adding different periods' social welfare, the discount factor is set to zero for simplicity.[10]

Figures 1 and 2 depict the results for the low expression cost ($\theta = 0.02$) case and the high expression cost ($\theta = 0.2$) case, respectively, both of which have quite similar patterns. In both cases, the highest average total social welfare is obtained in the design $(0.2, 50)$ and the lowest in the design $(0.8, 150)$. As a whole, narrower and shorter copyright is better than broader and longer copyright. In the mid-range, however, this pattern is not so clear, and there seems to be a substitutional relation between length and breadth. For example, the levels of total social welfare are relatively close between designs $(0.2, 150)$ (narrow and long copyright) and $(0.8, 50)$ (broad and short copyright).

[10]The assumption is innocuous because the creators' problem is not intertemporal choice.

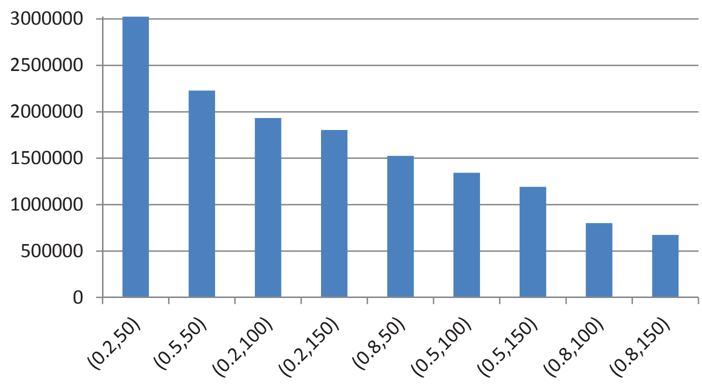

Figure 1: Average total social welfare: $\theta = 0.02$

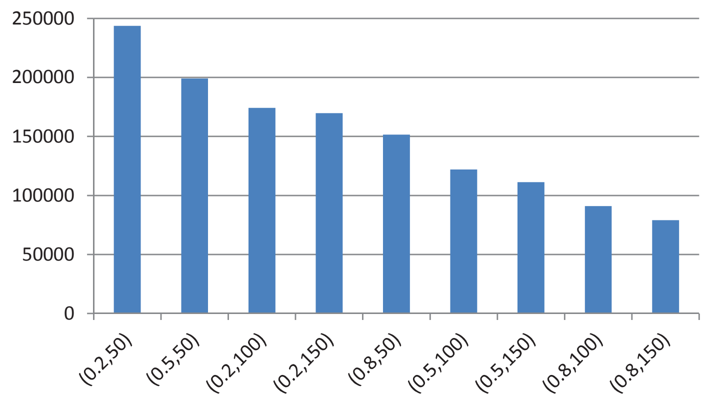

Figure 2: Average total social welfare: $\theta = 0.2$

Differences among the nine copyright designs can be more clearly observed with changes in w_t over 200 periods. Figures 3 and 4 depict the average w_t of 100 simulation runs in each period for low ($\theta = 0.02$) and high ($\theta = 0.2$) expression cost cases. Again, both results indicate the same time series pattern. Social welfare w_t for length 50 designs continued to grow after the 50th period, when the first period's works entered the public domain, for all three breadth parameters. The growth rates after the first copyright expiration periods were much smaller for length 100 designs and nearly zero (or even negative) for length 150 designs.

The simulation results reveal that length is more important than breadth for social welfare. The level of social welfare is larger in design $(0.2, 150)$ than in design $(0.8, 50)$ during more than half of all periods, which indicates that breadth impacts the level of social welfare. However, the growth of social welfare is much higher in design $(0.8, 50)$ than in design $(0.2, 150)$, and social welfare of $(0.8, 50)$ exceeds that of $(0.2, 150)$ after about the 150th period. Although length and breadth seem to be substitutional in the mid-range of total social welfare (Figures 1 and 2), short length, which boosts the growth of social welfare, can considerably impact social welfare in the long-run than narrow breadth.

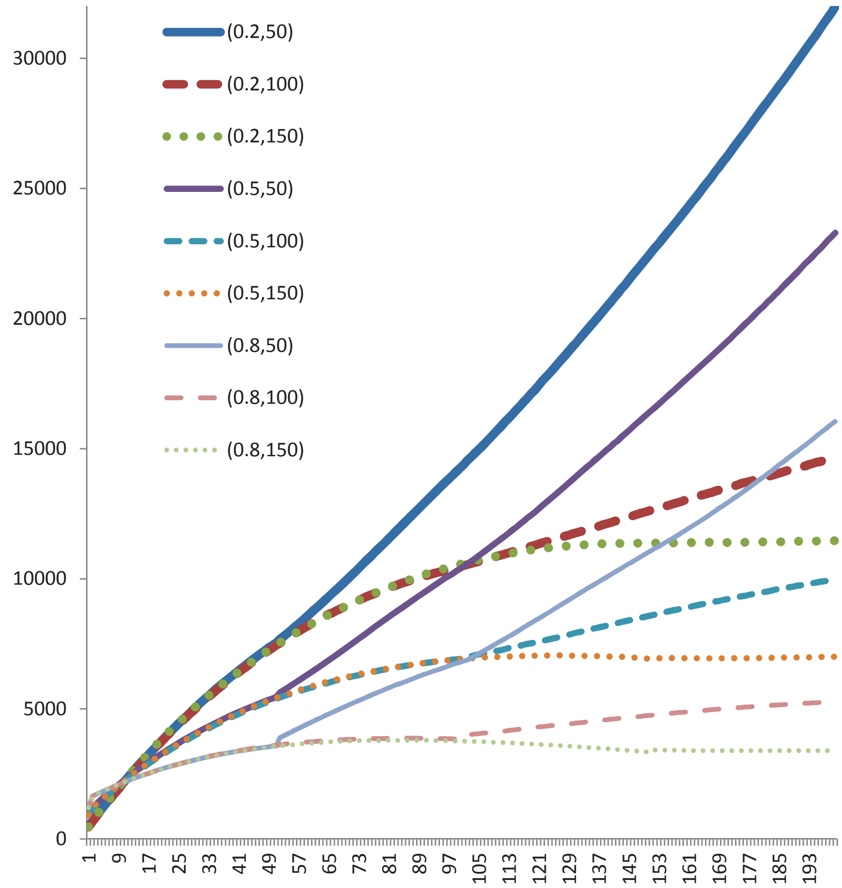

Figure 3: Average social welfare of each period: $\theta = 0.02$

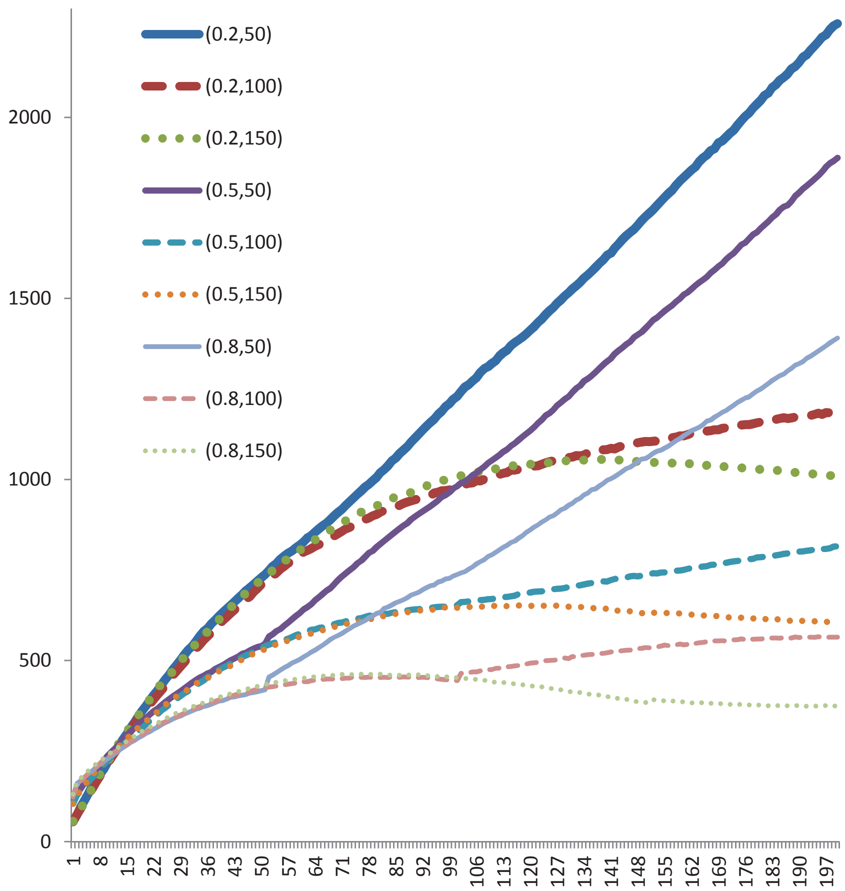

Figure 4: Average social welfare of each period: $\theta = 0.2$

A policy implication from these results is that the first priority for optimal copyright design is to shorten the length. Then, it is desirable to narrow the breadth. These results are robust with regard to different levels of expression costs. The reason for the importance of short length is that shorter copyright moves valuable works into the public domain faster, as Lessig (2002) argues. An increase in the number of public domain works decreases the expression costs of all creators and can boost the appearance of new works. Such effects of public domain works are larger if the copyright term is shorter because proprietary works enter the public domain while their values are higher. On the other hand, when the length is very long and the values of public domain works continue to decrease, the growth of social welfare can be suppressed, as in the case of length 150 designs. Therefore, long copyright, which is favorable only to particular creators possessing a large number of valuable proprietary works, is surpassed by short copyright, which is favorable to all other creators.

Finally, there is also a difference in the simulation results between two expression cost cases: the gap between the highest and lowest total social welfare is larger in the low expression cost case ($\theta = 0.02$) than in the high expression cost case ($\theta = 0.2$). In the low expression cost case (Figure 1), the highest total social welfare is 4.5 times larger than the lowest total social welfare; in the high expression cost case (Figure 2), the highest total social welfare is 3 times larger than the lowest total social welfare. As explained in section 2.2, Landes and Posner (1989) predict that the optimal level of copyright protection will decline if the expression cost is more responsive to a policy change. The simulation results of this study, on the other hand, show that a lower level of protection can be more effective when the expression cost is less responsive to a policy change. The reason for this is that creators are able to publish a large number of works under the low expression costs and further cost decreases due to weaker protection boost the large-scale publications.

4 Conclusion

Copyright protection is important for the provision of many commercial works. Few people question this role of copyright law. However, there has been disagreement regarding how copyright law should be designed. Previous studies have focused either on length or breadth of protection. This study, on the other hand, integrates them into a theoretical framework. The model also incorporates specific properties of creative industries and the cumulative feature of content creation: the cost of creating new works decreases when past works becomes more freely available, which resembles cumulative innovation models of the optimal patent design literature. The cost of this modeling approach is that the analytical solution for the optimal design is hard to obtain.

The simulation results imply that a shorter and narrower copyright is better for social welfare. Furthermore, copyright protection should first be short, regardless of the extent of its breadth. Length and breadth are not substitutes for the optimal design of copyright law. Short and broad copyright can outperform long and narrow copyright in the long run because the difference in length affects social welfare growth while the difference in breadth affects its level. These results are unchanged for different cost levels of creating new works.

The results differ from those of the optimal patent design literature for cumulative innovation, which states that the same initial investment incentive can be achieved under a short broad patent or a long narrow patent (Rockett, 2010). Unlike technological innovation, past and future creative works do not necessarily compete with each other, even when the latter borrows both the idea and the expression of the former (the *infinite variety* property). This makes imitation socially desirable because it efficiently boosts the variety of titles available to consumers. A real-world example of such an argument is Walt Disney's 1928 cartoon *Steamboat Willie*, which was created as a direct parody of the silent film *Steamboat Bill,Jr.* and which also brought Mickey Mouse to life (Lessig, 2004). Narrow and short copyright can be better than broad and long copyright because the cost of creation more significantly influences publication activities than the expected revenue does when the latter is highly uncertain (the *nobody knows* property).

A note of caution regarding copyright policy: narrowing the breadth may not be so effective when the length is very long. Some copyright law scholars argue that the digital age requires new user-privileges that grant users dramatically increased access to protected works compared with the fair use doctrine (Parchomovsky and Weiser, 2010). The results of this study imply that a policy change that dramatically narrows copyright breadth can raise the level of social welfare but cannot sustain its growth. Non-government groups' concern over TPP's copyright term extension could be real.

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