

## **INDEFINITELY RENEWABLE COPYRIGHT AND THE CURRENT COPYRIGHT SYSTEM: A TWO COUNTRY SETTING COMPARISON**

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ABSTRACT. As an alternative to the current copyright system (FLC), indefinitely renewable copyright (IRC) has not been compared to the current system in international settings. We compare them in a two country setting. We find that optimally configured IRC does not necessarily lead to higher national or global welfare than an optimally configured FLC.

### 1. INTRODUCTION

We compare infinitely renewable copyright (IRC) and the current copyright system in an international setting. The current copyright system faces serious technological and theoretical challenges. The current system is a fixed length copyright (FLC) system. Under FLC, certain exclusive rights are protected for a fixed period of time for creators of information products. The length of protection is fixed by the copyright authorities of individual countries, which are subject to influences from other countries. For example, the copyright length in the US is currently life plus 70 years, i.e. 70 years from the death of the last author to die for works of individual or joint authorship; and that in Canada or China is life plus 50 years.

IRC was proposed as an alternative to the current copyright system by Landes and Posner (2003). Under IRC, each creator has the option to renew the copyright of their works by paying a copyright fee.

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This study is partially supported by a Grants-in Aid for Scientific Research for the Promotion of Science [(B) 23402027 and (B) 20402023] in Japan.

IRC has been compared to FLC in single country settings. Landes and Posner discussed some desirable properties of IRC, relative to FLC, from possibly expanding the public domain, to reducing transaction costs, to avoiding rent seeking by right owners. They did not consider international issues. Adilov (2005) and Yuan (2006) compared IRC and FLC more formally also under single country settings. Adilov (2005) suggests that IRC and FLC can mimic each other without effecting the market outcome. Yuan (2006) suggests that IRC may lead to lower social welfare than FLC.

However, IRC should be compared to FLC under an international setting. It is apparent that any copyright system, if implemented, is likely to be international. Copyright works are easily traded across national borders. Consumers in one country benefit from works by foreign creators; creators in different countries compete with each other in both domestic and international markets. Therefore, the copyright laws of one country affect creators and consumers of this country as well as those of other countries; and copyright laws of different countries affect each other.

This paper describes the dynamics of IRC and FLC in a two country setting. In this setting, two countries, each with a creative industry and a market for information products, trade in these products. Under IRC, the copyright authorities of the two countries play a two-stage game against each other in setting copyright fees. At the first stage, the copyright authorities choose copyright fees per period per work charged to owners of copyrights of information products who sell the products on the respective two markets. At the second stage, creators react to the fees in deciding whether to renew the copyrights for their products in each of the markets and making other creative and marketing decisions to maximize profits. The copyright authorities set copyright fees to maximize social welfare of their respective countries, considering the effect on the behavior of the creators. Similar

dynamics under FLC in a two country setting is described in Yuan (2009). The two dynamics are compared in this paper.

The main result of the paper is that IRC does not necessarily lead to higher national or global welfare than the current copyright system. The comparison depends on the characteristics of demand. If consumers have a strong taste for variety or demand is very inelastic, IRC leads to higher national and global welfare. Otherwise, FLC may.

The rest of the paper is organized as follows. The next section describes the dynamics of IRC in a two-country setting. The third section compares the market outcome of dynamics of IRC and FLC. The paper then concludes.

## 2. INDEFINITELY RENEWABLE COPYRIGHT IN A TWO-COUNTRY SETTING

**2.1. The Market Setup.** Consider a simplified world information economy comprised of two countries. Each country has a sector of creators and a market for information products. A creator in either country develops first-copy information products and sells copies of these products on domestic and foreign markets.

The copyright authority of each country maximizes social welfare of its own country. It sets its copyright policy to maximize national welfare, taking the copyright policy of the other country as given. The policy adopted by a country applies to both domestic products and foreign products on the market of the country. If prices of the same products differ on the two markets, or if copyright protection on one market expires before the other, an effective ban on parallel importation will be assumed.

**2.2. The Model.** Under IRC, a copyright authority sets a copyright fee charged per period per work to copyright owners who sell information products in the country of the authority. The goal of the authority is to maximize the country's social welfare.

Owners of copyright works decide the length of copyright protection for their works in the country. Within the copyright duration, copyright owners enjoy, at least, partial monopoly power and can price their products above marginal cost of reproduction. Pricing above marginal cost causes a deadweight loss for consumer welfare and gives quasi-rent to creators. As sales revenue, net the reproduction cost, quasi-rent is necessary to recover the cost of developing the first-copy products and to pay the copyright fee. Creators choose prices to maximize the quasi-rent. Because the demand for given information products generally falls over time, the quasi-rent per period decreases over time. At a certain point of time, the quasi-rent per period will just equal the copyright fee of the period. And beyond that point, the quasi-rent will be less than the copyright fee per period. Therefore, the creators will stop paying the copyright fee and the products fall into the public domain at that point.

Creators of information products also decide how many first-copy products to create. They do so by considering the net profit per first-copy product. A first-copy product's net profit is the quasi-rent during the copyright life of the product, net of the total copyright fees paid during the copyright life, and net of the cost of developing the first-copy product. On average, different first-copy products compete for the budget of consumers of information products; they compete monopolistically. The net profit per first-copy product decreases as more first-copy products are introduced to the market. At some point, the net profit from an additional first-copy product will fall to zero. And beyond that, an additional first-copy product brought to market by a creator earns negative net profit for the creator. That point determines the number of first-copy products chosen by the creator.

All creators on the market choose copyright duration, the prices of their products, and the number of first-copy products simultaneously. Equilibrium among the creators on the market is reached when each creator's decisions are optimal, given the decisions of other creators and copyright fees set by copyright authorities.

Creators decide whether to stay on the market; potential creators decide whether to enter the market. If the marginal creator on the market makes negative economic profit, the marginal creator will exit the market. If the economic profit of the marginal creator is positive, additional creators will be attracted to enter, assuming there is a continuous flow of potential creators. Equilibrium is reached when the marginal creator makes zero economic profit. Assuming all creators have the same technologies, all creators will make zero economic profit at the equilibrium. This equilibrium between the creators on the market and potential creators determines the number of creators on the market, given the copyright fees set by the copyright authorities.

The copyright fee affects the decisions of creators. As the copyright fee becomes higher, the copyright duration will be shorter; the quasi-rent from selling copies of a first-copyright product during copyright protection may be smaller; fewer first-copy products may be created; the overall profitability of a given number of creators on the market may decrease; there will be fewer creators and fewer first-copyright products on the market.

The copyright fee has two effects acting in opposite directions on consumer welfare. On the one hand, a higher copyright fee decreases consumer surplus by decreasing the number of first-copy products on the market. On the other hand, a higher copyright fee may increase consumer welfare by reducing the copyright duration chosen by creators, reducing the deadweight loss from existing information products on the market.

The copyright fee also has two effects acting in opposite directions on the copyright revenue collected by a copyright authority. On the one hand, a higher copyright fee means higher revenue directly, given the number of first-copy products and number of renewals of copyrights for these products. On the other hand, a higher copyright fee may decrease revenue by reducing the number of first-copy products and number of copyright renewals by creators.

The copyright authorities care about social welfare. Assuming all creators have access to the same technologies, social welfare in a country equals the sum of consumer surplus and copyright revenue of the copyright authority of the country, since all creators make zero economic profit.

The copyright authority chooses the optimal copyright fee to maximize social welfare, balancing the opposite effects of the fees on consumer surplus and copyright revenue.

Finally, the optimal copyright fee for a copyright authority in one country depends on the copyright fee set by the copyright authority of another country. The copyright fee of the other country affects consumer welfare of the first country by affecting the creative decisions of creators of the other country, who sell their information products in the first country, and by affecting creative decisions of creators of the first country, who export and sell their products in the other country.

An equilibrium in copyright fees is reached if each country's copyright fee is optimal, given the other country's copyright fee.

The above dynamics constitutes a two stage game. At the first stage, the copyright authorities play a simultaneous game in setting copyright fees to maximize each country's social welfare. At the second stage, individual creators choose prices, copyright durations, and numbers of first-copy products to maximize individual profits, and they decide whether to stay on the market, given the copyright fees set by the copyright authorities.

Similarly, FLC constitutes a two stage game. The difference is that under FLC, the copyright authorities set the copyright durations in their respective countries at the first stage; at the second stage, creators choose prices and numbers of first-copy products and decide whether to stay on the market, given the copyright durations set by copyright authorities.

### 3. SOLUTION

The two games can be written in mathematical form and solved numerically. The mathematical models and solution procedures are omitted here for readability. The solution requires a set of demand functions for information products and cost functions of creators in the two countries. These functions contain a set of parameters, describing the properties of the market and the creative technology of the industries. These parameters are listed as follows:

$D_1, D_2$ : demand levels in the two countries;

$\alpha$ : the percentage increase in demand per one percentage increase in the number of first-copy products. It describes consumer preference for variety of information goods;

$\delta$ : price elasticity of demand for information goods;

$\beta$ : cross price elasticity of information goods;

$b$ : reproduction cost of information products;

$T_{01}, T_{02}$ : economic life of information products in the two countries;

$\theta_1, \theta_2$ : residual demand levels for information products in the two countries; Demand levels in the two markets decrease to  $\theta_1$  and  $\theta_2$  of the original demand levels at time  $T_{01}(1 - \theta_1)$  and  $T_{02}(1 - \theta_2)$ .

$\gamma$ : social discount rate;

$c_{01}, c_{02}$ : fixed cost of becoming a creator in the two countries;

$a_1, a_2$ : per product creative cost parameters in the two countries;

$\rho_1, \rho_2$ : economies of scale in creation in the two countries.

The parameters without subscript are assumed to be the same across the two countries. The following variables describe the market outcome of the systems:

$p$ : price per copy of products in the two country.;

$s_1$  and  $s_2$ : number of first-copy products per creator in the two countries;

$S$ : total number of first-copy products;

$T_1$  and  $T_2$ : copyright duration in the two countries;

$f_1$  and  $f_2$ : copyright fees in the two countries;

Note that, in principle, the price per information product,  $p$ , may differ across products, creators and country; the size of a creator in country one,  $s_1$ , and  $T_1$ , the copyright length chosen by a country 1 creator, may differ across creators in country 1; likewise for  $s_2$  and  $T_2$  for country 2. They do not differ in the results obtained here under the assumed identical demand and cost functions across creators within each country.

Given specific values to the market parameters, the market outcome variables can be solved from the models describing the above dynamics. For example, assume the following values for the parameters:

$$\begin{aligned} & [D_1, D_2, \alpha, \delta, \beta, b, T_{01}, T_{02}, \theta_1, \theta_2, \gamma, c_{01}, c_{02}, a_1, a_2, \rho_1, \rho_2] \\ = & [7 \times 10^7, 7 \times 10^7, 0.42, 0.55, 100, 100, 0.001, 0.001, 0.05, \\ & 3 \times 10^6, 3 \times 10^6, 10^4, 10^4, 1.2, 1.2] \end{aligned}$$

The market outcome variables from the solution to the model are shown in Table 1.

These parameter values have not been selected to represent any particular real market but rather to be within reasonable ranges and will be changed later. According to the above parameter values, the creators of two countries are assumed to have the same technologies, and consumers the same preferences.



Table 1: A Comparison of IRC and FLC

	<b>IRC</b>	<b>FLC</b>
Country 1 copyright fee: $f_1$ (\$)	933	n/a
Country 2 copyright fee: $f_2$ (\$)	933	n/a
Country 1 duration: $T_1$	61	11
Country 2 duration: $T_2$	61	11
Country 1 creator size: $s_1$	443	443
Country 2 creator size: $s_2$	443	443
Number of first-copy products: $S$ (1000)	1,271	1,168
Number of copies sold in first 100 years (Billion)	78	145
Country 1 social welfare: $W_1$ (\$B)	122	142
Country 2 social welfare: $W_2$ (\$B)	122	142

The results show the following. Under IRC, the copyright fees in the two countries are both \$933 per product per year. They induce creators to choose 61 years of copyright protection for their products, much longer than the optimal 11 years under FLC. Creators in the two countries create 1,271,401 first-copy products under IRC, 9% more than under FLC. The number of first-copy products created by each creator will be about 433 under both IRC and FLC. Global consumption of information products in the first 100 years is 78 billion copies under IRC, 46% fewer than the 145 billion copies under FLC. Finally, social welfare of each country is \$122 billion under IRC, 14% lower than the \$142 billion for each country under FLC.

Figures 1 and 2 show the optimality of the IRC solution. Figure 1 shows that, first, each creator makes zero economic profit; second, the copyright duration of 61 years and size of 443 first-copy products are optimal for each creator, given the copyright fee set by copyright authorities and the optimal copyright durations and sizes chosen by other creators. If a creator deviates from the duration and size, the creator will incur a loss.

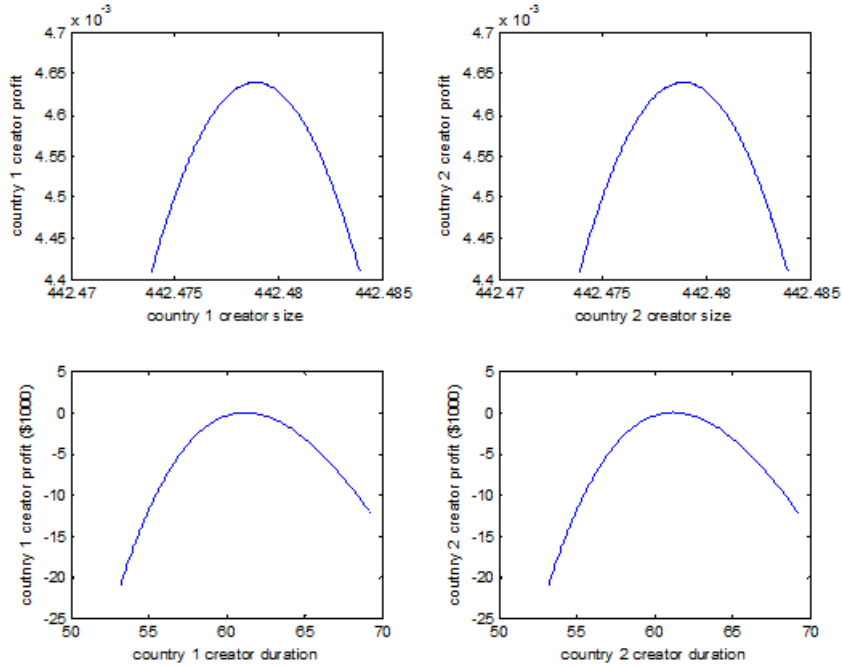


FIGURE 1. Optimality of Copyright Duration and Creator Size

As shown in Figure 2, the copyright fee of \$933 per product per year is optimal for each country, given that the other country sets the optimal fee and creators respond to copyright fees as described above. If either country deviates from the optimal copyright fee, the social welfare of the country will be lower than the maximum of \$122 billion, given that the other country maintains its optimal fee and the creators react to copyright fees as described.

Figure 3 further shows that the copyright fees represent the equilibrium of a game of copyright fees between the two countries. The fees are the intersection of the two reaction functions. The dotted line is the reaction function of copyright fee of country 2 to the copyright fee of country 1. The solid line is that of country 1 to country 2.

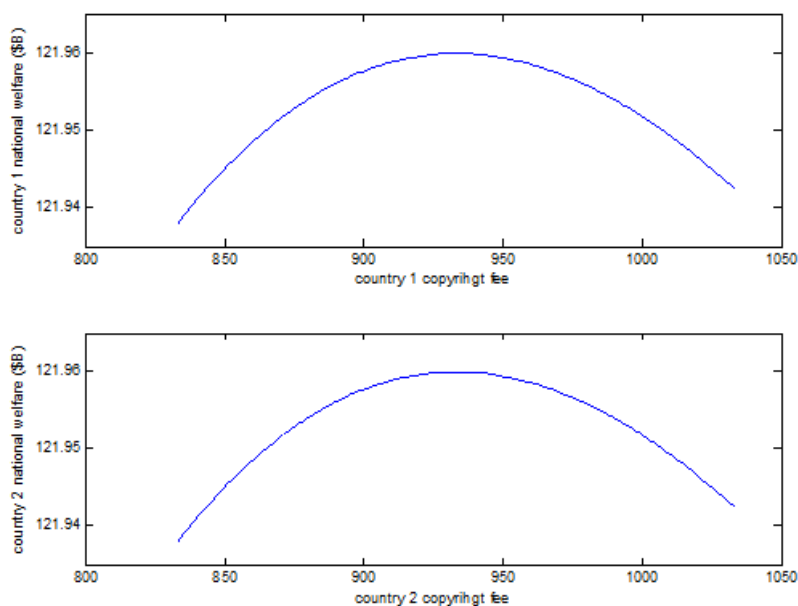


FIGURE 2. Optimality of Copyright Fee

Figures 4 and 5 show the effects of the copyright fee of country 1, given that copyright fee of country 2 stays at the equilibrium level of \$933. If country 1 increases its copyright fee, first, creators will choose a shorter copyright duration in that country and the creators will choose a longer duration in the other country, as renewal of copyright in the other country becomes relatively cheaper; second, creators in the two countries together create fewer first-copy products; third, the copyright revenue of country 1 first increases, indicating the effect of higher fee is dominant; it then decreases, indicating the effect of fewer renewals and fewer first-copy products become dominant; fourth, the consumer surplus of country 1 first decreases, when the effect of fewer first-copyright products dominates; it then increases, when the effect of reduced loss of consumption due to shorter copyright protection in the country dominates; fifth, the national welfare of country 1 reaches a local optimum at copyright fee of \$933. The national welfare suffers when the

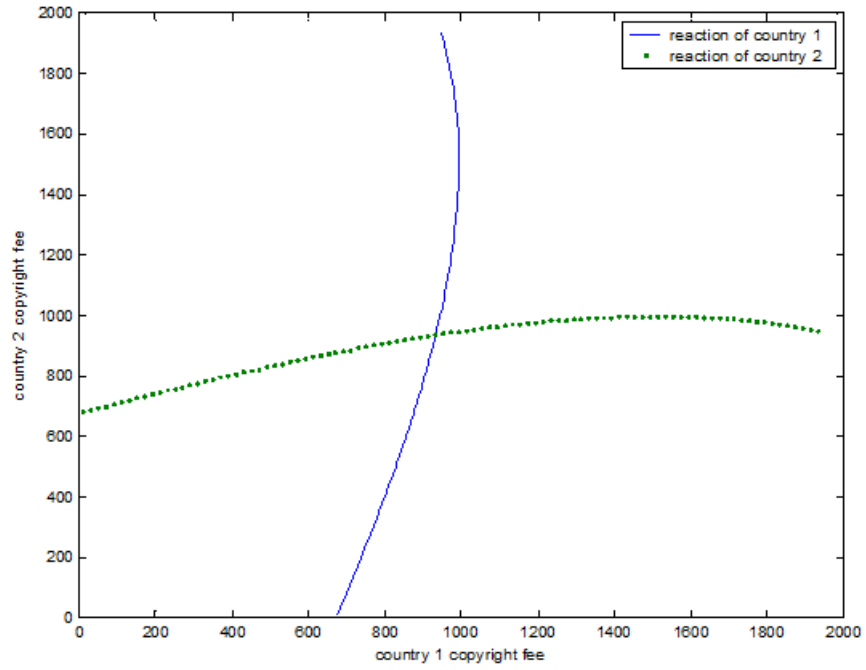


FIGURE 3. Copyright Fee Equilibrium between the Two Countries

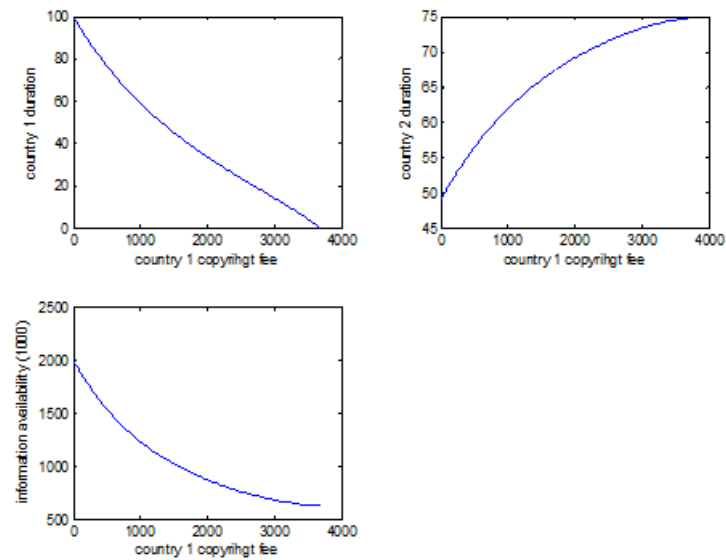


FIGURE 4. Effect of Copyright Fee of Country 1 on Creator Behavior

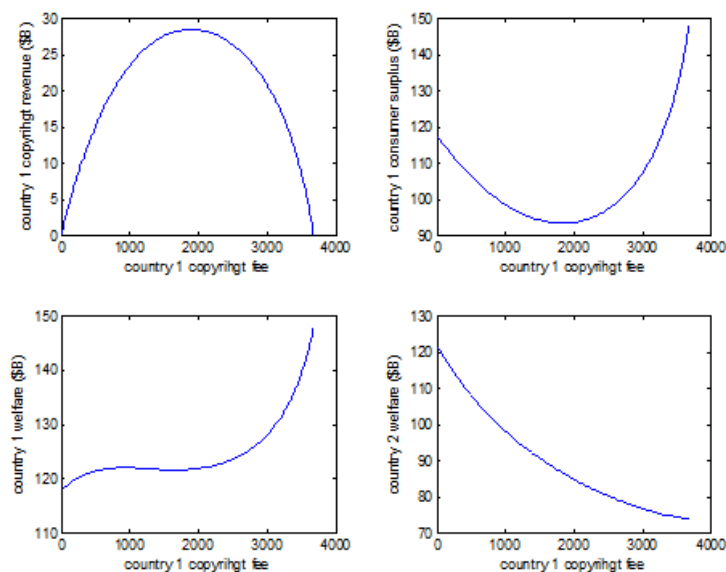


FIGURE 5. Effect of Copyright Fee of Country 1 on Revenue and Welfare

country deviates from this fee. However, the optimum of national welfare is not global. A much larger copyright fee would give the country even higher welfare than the optimum at \$933. However, the higher fee is not stable because it is not an equilibrium fee. That is, the copyright fee of other country would not remain at \$933, if the copyright fee of this country is higher than \$933.

In summary, IRC is not necessarily better than FLC in terms of social welfare. It can lead to lower welfare in both countries. This is similar to the result of Yuan (2009). Second, IRC seems to lead to longer copyright protection. However, the longer protection is not necessarily good in terms of social welfare. In the case of the above parameter values, longer protection results in over-supply of original information products and under-consumption of information products.

An important question is whether and how the comparison changes with consumer preference and creative technologies. To partially answer this

question, we look at the effects of changing the individual parameter values, while keeping other parameters at the baseline values. These effects are obtained by solving the model with the changed parameter values repeatedly. Solutions are found with the individual parameters in the following ranges:  $D_1, D_2$ :  $6.724 \times 10^7$ - $7.279 \times 10^7$ ;  $\alpha$ : 0.388-0.4995;  $\delta$ : 1.504-2.204;  $\beta$ : 0.1-0.9;  $b$ : 1-50;  $T_{01}, T_{02}$ : 92.4-100;  $\theta_1, \theta_2$ : 0.0001-0.3;  $\gamma$ : 0.031038-0.3;  $c_{01}, c_{02}$ :  $5.4 \times 10^5$ - $3 \times 10^7$ ;  $a_1, a_2$ : 6370-15940; and  $\rho_1, \rho_2$ : 1.1604-1.249104. We find that solutions for parameter values out these ranges do not converge in the numerical procedures.

For all the above parameter value changes, the copyright duration remains longer under IRC than under FLC. However, the comparison of welfare between IRC and FLC flips with changes in consumers' preference for variety and the price elasticity of demand. Figures 6 and 7 show the effect of the parameters  $\alpha$  and  $\delta$  on the decisions of national copyright authorities, those of creators, and the market outcome. The figures apply to both countries, as the parameter values are symmetric with regard to the two countries.

The parameter  $\alpha$  describes the preference of consumers for variety of information products. In Figure 6, the copyright fees set by the copyright authority decrease with  $\alpha$ ; the copyright duration increases with  $\alpha$  under both IRC and FLC, but it increases faster under IRC than under FLC. Under IRC, creators respond directly to consumer preference and indirectly to lower copyright fees. The number of first-copy products increases with  $\alpha$  under both IRC and FLC, however, it increases faster under IRC for the same reason. National welfare increases with  $\alpha$  under both IRC and FLC, but it increases faster under IRC. As a result, when  $\alpha$  is smaller than 0.45, national welfare under LFC is higher than under IRC, and when  $\alpha$  is greater than or equal to 0.45, national welfare under IRC is higher than that under FLC.

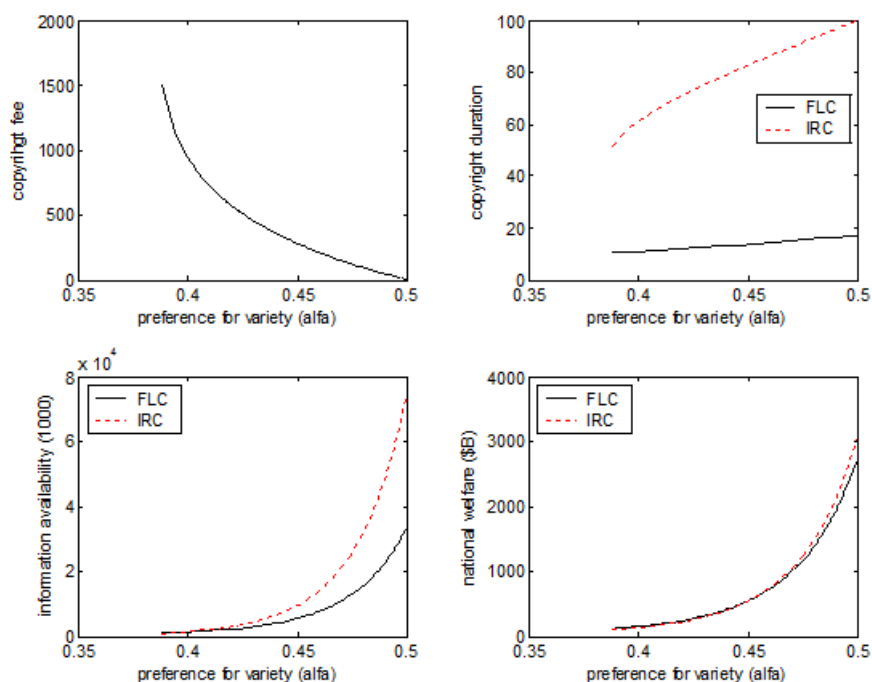


FIGURE 6. Effect of Consumer Preference for Variety

The effects of  $\delta$  are similar. The parameter  $\delta$  is the price elasticity of demand. A smaller  $\delta$  represents a stronger demand for information products. The copyright fee decreases when  $\delta$  decreases or when demand becomes less elastic. The copyright duration increases under both IRC and FLC, when  $\delta$  decreases, but it increases faster under IRC. The number of first-copy products under both IRC and FLC increases when  $\delta$  decreases, however, it increases faster under IRC. National welfare increases under both IRC and FLC, when  $\delta$  decreases, but it increases faster under IRC. For  $\delta$  above 1.68, national welfare under FLC is higher. For  $\delta$  at or below 1.66, national welfare under IRC is higher.

In summary, the copyright duration is longer under IRC than under FLC. The longer protection under IRC leads to higher national and global welfare

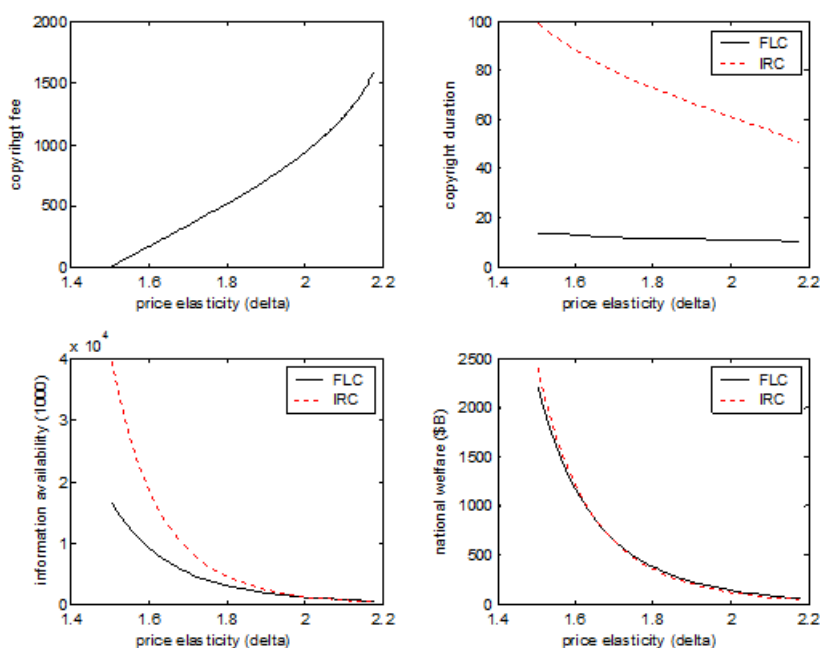


FIGURE 7. Effect of Price Elasticity

when consumer preference for variety is stronger and demand is inelastic. Otherwise, it results in lower national and global welfare.

Why may IRC lead to longer protection of copyright than FLC? There may be two reasons. First, the two-country FLC may have a bias toward short copyright protection. Copyright authorities set copyright duration competitively under FLC in the two-country setting. The copyright authority in each country has an incentive to set a short protection in its country to let its consumers enjoy the information products more and let the other country provide the protection necessary for creators to create the first-copy products. This may be the critical difference of the two country setting FLC from the single country FLC in (Yuan, 2006).

On the other hand, IRC may have a bias toward long copyright protection. IRC lets creators choose the duration of copyright for their products.



Creators prefer longer protection. The authorities use copyright fees to induce them to choose socially proper length of protection. However, creators may also respond to the copyright fee in ways other than copyright duration, such as in creative and entry decisions. And they may pass part of the fees to consumers. When the copyright authorities use the copyright fee to induce creators to choose the socially proper duration, it must consider these “side effects”. The side effects may prevent the copyright authorities from inducing creators all the way to the socially optimal copyright duration. This means that the copyright duration under IRC may be biased toward the preference of the creators, making it longer than under FLC.

The result suggests that when the preference for variety is weak or demand is elastic, the bias toward long copyright duration of IRC is excessive. Then IRC leads to lower welfare. On the other hand, when the preference for variety is strong or demand is inelastic, the bias toward short copyright duration of FLC becomes excessive. In this case FLC leads to lower welfare than IRC.

Figures 8 and 9 show the different comparisons of welfare of country 1 between FLC and IRC for two different values of  $\alpha$ . Figure 8 is for  $\alpha = 0.4$ , and Figure 9 is for  $\alpha = 0.49$ . In the figures, the welfare of country 1 under FLC is welfare assuming that country 2 stays at the equilibrium duration under FLC for the given values of  $\alpha$ , which are 11 years for  $\alpha = 0.4$  and 17 years for  $\alpha = 0.49$ . The duration for IRC is the duration chosen by creators at various levels of the copyright fee in country 1, assuming that country 2 stays at the equilibrium copyright fee under IRC for the given values of  $\alpha$ , which are \$933 for  $\alpha = 0.4$  and \$4 for  $\alpha = 0.49$ .

In figure 8, where  $\alpha$  is at the smaller value 0.40, the optimal copyright duration under FLC is 11 years; the optimal duration under IRC is 61 years, which is induced by a copyright fee of \$933 per product per year. And the

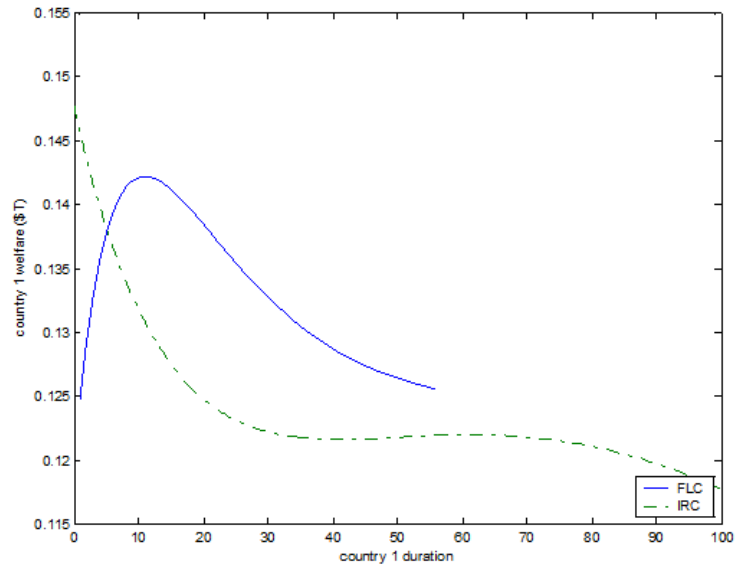


FIGURE 8. Welfare Comparison of FLC and IRC at Different Copyright Durations ( $\alpha=0.40$ )

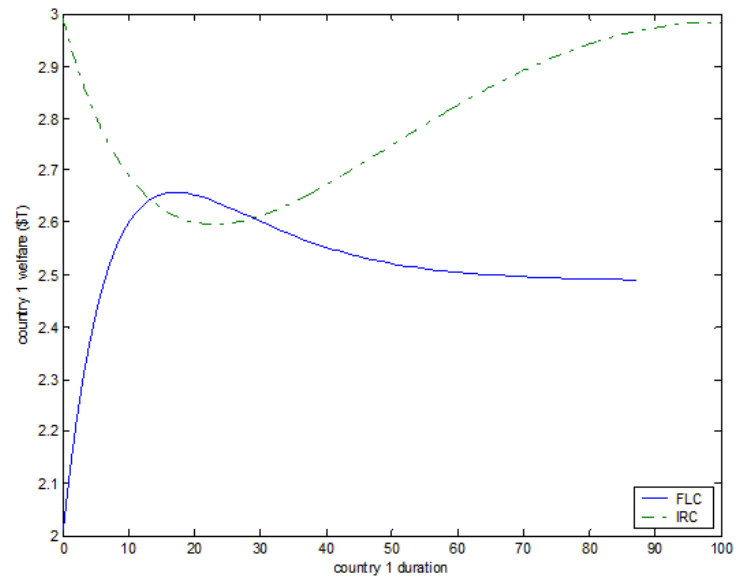


FIGURE 9. Welfare Comparison of FLC and IRC at Different Copyright Durations ( $\alpha=0.49$ )

optimal welfare of country 1 under FLC, reached at duration of 11 years, is \$142 billion, higher than that of \$122 billion under IRC, reached at the duration of 61 years.

In figure 9, where  $\alpha$  is at a bigger 0.49, the optimal copyright duration for country 1 under FLC is 17 years; the optimal copyright duration under IRC is 100 years, induced by a copyright fee of mere \$4. And the optimal welfare of country 1 under FLC, reached at duration of 17 years, is \$2.7 billion, lower than that of \$3.0 billion under IRC, which is reached at the duration of 100 years.

#### 4. CONCLUSION

We have described the dynamics of indefinitely renewable copyright (IRC) in a two-country setting and compared it to the current fixed length copyright (FLC) system under the same setting. Under IRC, the copyright authorities of two countries are described as playing a simultaneous game in setting the copyright fee, and creators choose copyright duration and make pricing and creative decisions in order to maximize profit given the fees. Similarly, under FLC, the copyright authorities play a game in setting the copyright duration, and creators only make pricing and creative decisions. We find that national and global welfare under IRC are not necessarily higher than under FLC or vice versa. National and global welfare under IRC can be larger than under FLC when consumer preference for variety is strong or demand is inelastic. Otherwise, welfare under IRC is smaller. Copyright duration under IRC seems to be always longer than that under FLC.

Alternative descriptions of the dynamics of copyright policy making in international setting are possible. For example, copyright authorities may play sequential and asymmetric and cooperative games. These other possibilities, and more comprehensive comparisons of IRC and FLC considering other factors, such as transactions costs, are left for future studies.

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