PROPERTY RIGHTS IN COMPUTER SOFTWARE:
SOME COMMENTS ON THE EVOLVING
INTERNATIONAL FRAMEWORK

By

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ABSTRACT

This paper analyses whether the Japan–United States copyright standard provides an efficient international framework for establishing intellectual property rights (IPRs) in computer software. The economic rationale for intellectual property rights is presented and the analysis is extended to computer software. After considering the substantial transaction costs associated with defining, tracing, and enforcing intellectual property rights in computer software, I conclude that copyright law is likely to produces less deadweight loss than other types of intellectual property rights.

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Professor Harold See's paper provides a comparative analysis of property rights in computer software in the United States and Japan. He finds "that in large measure these laws of the two countries are substantially identical" (p. 40). Property rights in software are established primarily by copyright law in both countries.¹ The rights established by each country's copyright laws are far from identical in their details, yet are broadly similar in their essential provisions. Both award long-term property rights (the life of the author plus fifty years) to the software's creator. Both are signatories to the Berne Convention for the Protection of Literary and Artistic Works and have copyright laws consistent with the convention's provisions. Neither country requires formal registration to acquire copyrights.² Both countries allow authors to control most uses of their copyrighted works and to earn income from their use.

Other industrialized countries have also decided to use their copyright laws to establish property rights in computer software rather than patent law or sui generis property rights. France has, however, reduced the term of copyright protection for software from 50 to 25 years, while Germany allows rights in software to be established by a system of petty patents. Most developing countries failed to recognize property rights in computer software until the early 1980s, and their transition to an IPR system based on law was far from voluntary. They adopted copyright protection for software only after the United States government threatened to suspend selected trading privileges for countries failing to adopt minimal standards of property rights for production processes, new products, creative works, and computer software. Sui generis proposals for computer software protection were proposed in 1971 by the World International Property Organization but have not been adopted by member countries. In 1983 the Japanese Ministry of International Trade and Industry (MITI) put forth its own
sui generis program of protection which combined copyright and industrial property right principles. Following the lead of most other countries, the Cultural Affairs Agency of the Ministry of Education proposed to use copyright law to protect computer software, and this proposal was ultimately adopted by the Diet in 1985.

This paper analyses whether the Japan-United States standard provides an efficient international framework for establishing and coordinating intellectual property rights (IPRs) in computer software. I begin by sketching the economic rationale for intellectual property rights, and then extend the analysis to computer software. The discussion focuses on how the demand for different dimensions of copyright law varies across countries and examines whether the Japan-U.S. standard for IPRs in computer software provides an efficient international standard. After considering the substantial transaction costs associated with defining, tracing, and enforcing intellectual property rights in computer software, I tentatively conclude that the use of copyright law to establish IPRs in computer software produces less deadweight loss than other types of intellectual property rights.

I. AN ECONOMIC RATIONALE FOR INTELLECTUAL PROPERTY RIGHTS

Fully specified property rights in tangible and intangible goods are basic building blocks in most neoclassical economic models, as they provide individuals with incentives to use resources efficiently. The Coase Theorem tells us that in the absence of transaction costs and income effects, pure private property rights and maximization by economic agents are sufficient in a competitive economy to establish efficient resource use regardless of how the rights are structured or distributed.\(^3\)

Positive transaction costs alter this strong result in several ways. First,
positive transaction costs limit opportunities for trade. As transaction costs increase, exchange decreases. Thus maximization of two parties' joint welfare becomes increasingly dependent on the initial specification and distribution of property rights. Exchange is hampered because the buyer has little information about the unprotected dimensions of the product, while the seller cannot easily reveal information about these dimensions, as this lowers the cost of imitating the product (Arrow, 1962). This problem is important for the exchange of rights to computer software, as the copyright only protects the computer code and does not cover the knowledge of possible future improvements uncovered by the code's writers during the program's development.

Second, positive measurement costs increase the cost of delineating and tracing property rights. Resources must be expended to define the property and to specify which dimensions of the good are to be provided protection. After the property is defined, it must also be determined whether sufficient criteria to establish property rights are met. This process often involves an expenditure of resources to trace the origin of the good and/or to determine whether it is sufficiently different from other goods. For example, a buyer of land usually hires a lawyer to conduct a title search to determine whether the rights to the land actually adhere to the seller. For creative works, resources may be spent (by private or public parties) to determine whether a creative work has been copied or, more generally, whether it is a sufficiently original work. In the presence of positive measurement and delineation costs, it will not pay to define property rights in creative works across all of their dimensions, as there is a tradeoff between the marginal resources devoted to tracing and defining additional dimensions and the benefits derived from defining property rights over marginal dimensions. In the presence of positive transaction costs, property
rights will not be defined across all dimensions of the good.

Positive enforcement costs also affect the value of property rights and are closely related to how well the property right is delineated. Costly enforcement provides incentives for rent-seeking individuals to incur costs to appropriate some dimensions of property and for rights holders to allocate resources to enforcement. One implication of positive enforcement costs is that some dimensions of a good voluntarily become common property, as owners and the state find it too costly to protect all margins of all property against appropriation. To limit the amount of property entering the common domain, efficient property rights are structured to reduce private and public costs of enforcement. This usually means that only some dimensions of a good are protected by a system of publicly-enforced property rights. Although incomplete property rights reduce gross benefits, the reduction in enforcement costs is often sufficient to increase the net value of the property rights package. This analysis is particularly relevant for computer software, as the process of tracing the originality of computer code and its on-screen presentation is very costly.

Intellectual property differs from most tangible property because it has one of the two characteristics of a public good: a nonexclusive consumption technology. Additional users can consume the work without incurring additional production costs beyond the cost of copying the property. This implies that the optimal price for using intellectual property is zero. Given the existing set of knowledge and technologies, static efficiency is achieved if the price charged for the nontangible good is equal to the marginal cost of reproducing the good. Dynamic efficiency is, however, violated when the good's price equals the marginal cost of reproduction, as the rate of return on producing new works falls below the competitive return on other investments, thereby reducing resources
devoted to prospecting for new creative works.

In the absence of transaction costs is it possible to find a method for compensating authors which reduces deadweight loss to zero? Assuming that lump sum taxes are infeasible, compensation of the creators of intellectual property is financed either from general taxation or user charges for the nontangible public good. Both methods of financing this investment generate deadweight losses.⁴ An efficient first-best equilibrium, which requires that deadweight losses be eliminated, cannot be attained for intellectual property. The best possible equilibrium that can be achieved is one in which deadweight loss is minimized rather than eliminated; Arnott and Stiglitz (1986) characterize this second-best equilibrium as constrained efficient.⁵ Even the second-best equilibrium may not be reached, as this equilibrium presumes that government will have incentives to structure IPRs efficiently. If decisionmakers in government have incentives to alter the second-best equilibrium to satisfy politically powerful coalitions of interest groups, then the resulting equilibrium will be further disorted and is often characterized as a third-best equilibrium. For our purposes the critical analytical result is that property rights in intellectual property must be incomplete across various dimensions in order to achieve constrained efficiency.

An efficient government may be able to minimize deadweight loss resulting from restricted intellectual property rights by utilizing an optimal mix of taxes and subsidies. Suppose government takes action to subsidize production of the good embodying the intellectual property. Deadweight loss resulting from underuse of the intellectual property is reduced, as buyers use more of the intellectual property when the price of the product containing the intellectual property decreases. Similar effects are generated when government subsidizes productions
of goods complementary to the intellectual property. If the marginal deadweight loss from the extra taxation (to finance the production subsidies) is less than the marginal reduction in deadweight loss from underuse of the intellectual property, then overall deadweight loss is reduced when the package of intellectual property rights is jointly determined with a package of taxes and subsidies.

One example of this type of subsidy may be an investment tax credit. Suppose that the rate of technological and creative change increases. Gross investment in the new environment is now more likely to be directed towards the production of new products protected by IPRs. A subsidy to investment, such as an investment tax credit, reduces the rental rate on capital, thereby decreasing the marginal cost of producing the product embodying the IPR. If the subsidy to investment is set correctly, the deadweight loss from intellectual property could be minimized although not eliminated.

Most OECD countries compensate authors of creative works and inventors of new products and processes by awarding them restricted property rights in their work. IPRs increase the production of creative works and innovations by allowing creators to charge a price above marginal cost and thereby earn a quasirent on product production. Patents and copyrights are the most widely used form of IPRs. Patents provide relatively broad coverage of the idea behind an invention and have a short term. By contrast, copyrights provide a narrow band of protection for a creative work and have a longer term than patents.

What determines the optimal life and the breadth of coverage of an IPR? Nordhaus (1969) and Scherer (1972) theorized that the optimal patent term would be one where the marginal deadweight loss from monopoly pricing was equal to the marginal gain from the increased flow of inventions. This traditional theory of
optimal patent life has been challenged during the 1980s, as economists have
recognized that the flow of inventions/creative works is also affected by the
breadth of protection. Novos and Waldman (1984) and Johnson (1985) have
identified an additional cost resulting from strong protection. When protection
is set at high levels and producers are able to charge monopoly prices, the
consumer spends up to the monopoly price to secretly copy the product. This means
that illegal copies of the product or literary work may be produced at a higher
cost than would be incurred by the patent or copyright holder. These additional
costs should be considered in any normative discussion of optimal patent lives.

Waterson (1990) has observed that broad band patent protection generates
less variety than narrower band copyright protection and that optimal choice of
IPRs also depends on consumer demand for product variety as well as the
traditional tradeoffs between the overall flow of new products and static
efficiency. However, the weaker protection offered to the inventor/author by
narrower IPR protection (such as copyrights) may also generate a reduced flow of
high cost, fundamental innovations. In addition, some of the additional variety
may be produced merely to circumvent the copyright and is, therefore, socially
wasteful. In the next section we apply the analysis outlined above to the choice
of IPRs in computer software.

II. IPRS FOR COMPUTER SOFTWARE IN JAPAN AND THE UNITED STATES

The use of copyright law to establish IPRs in computer software in Japan
and the United States is consistent with many of the considerations outlined
above. First, like many other creative works protected by copyright, computer
software is a relatively easy product to define under the copyright law. Unlike
many other new innovations, the idea is largely embodied in a tangible product
(the object or source code) that is readily observable. Copyright law allows
virtually all authors of original programs to obtain immediate property rights; neither registration of copyright nor explicit determination of originality is required by copyright law. On the other hand, patent law, because it offers broader protection to the inventor, requires more careful delineation of the claim, a process that often requires several years of research. During the review period the inventor receives no protection. Given the short life (and similarity) of many software programs, delayed protection could mean no protection at all.

Second, American and Japanese patent law both require that the invention be nonobvious. The invention also has to be novel and useful. These requirements mandate considerable research if a sequence of computer code is being patented. Whether or not a particular computer routine is nonobvious and novel is a difficult question. Novelty is likely to be costly to determine given the massive volume of existing computer code and the likelihood of repetition of simple routines. And as See (p. 11) observes, an "invention is not novel if it is known by others at the time it is invented." Tracing the ideas behind a software package is a relatively high cost activity given the multiplicity of ideas used in a program and the difficulty of comparing their expression with those in other programs. Copyright law reduces these problems, as it allows the development of products that are closer substitutes in their expression and use. Furthermore, it does not require investigation of whether the product is nonobvious, the major reason for denial of patent applications.

Third, in spite of advances in developing safeguards against copying, it is relatively low cost for users to copy most personal computer software. Copyright law, by providing a narrower band of protection than patent law, implies that the monopoly prices charged by the IPR holder will be closer to competitive prices; this is because copyright law encourages greater development
of close substitutes by competitors than patent law does. The increased product
variety comes at the cost of less fundamental innovation. This cost is likely to
be relatively small, as broader protection of fundamental innovations reduces
close imitation by competitors but does little to prevent clandestine copying by
consumers. Broader protection serves no purpose if it does not enable the
producer to charge a higher price. If it were feasible to restrict consumer
copying or to ascertain at low cost whether a consumer is using a copied program,
then broader protection of more fundamental innovations might be warranted.

This point is particularly important for the analysis of computer operating
systems. Most applications programs are designed for a specific operating system,
and most users adopt a single operating system. Since the cost of developing a
new operating system is likely to be relatively high and the cost of imitating
the system to be relatively low, broader protection may be necessary to induce
development of operating systems. This argument is blunted by the ease with which
consumers can copy operating systems; if the purchaser of the software is unable
to collect payment for the copies, then the software company cannot charge a
price substantially above marginal cost for the operating system. Since broader
protection does not produce substantially higher prices for the software creator,
fundamental advances in operating systems receive no impetus from the IPR. Given
the low consumer copying costs there are gains from instituting a narrow IPR and
attaining additional variety in microcomputer operating systems. This argument
does not, however, apply to operating systems for mainframes. Mainframe computers
require continuing services from the software manufacturer, thereby reducing the
cost to the manufacturer of monitoring consumer copying activity.

Fourth, copyright law provides incentives for the software's author to add
marginal improvements to the software package. This is particularly important
because of the ease with which computers can be reprogrammed. Because computer storage devices, such as hard disks or tape drives, can be easily erased and reprogrammed, updated software programs can be cheaply installed in the computer(s) by the user or his agent. Extended copyright protection allows a software producer to add improvements to the software without facing competition from an earlier version of the program embodying many of the updated program's central features. At the same time, low cost installation of new, similar software provides incentives for the software company to develop (or purchase) improvements to its program to maintain its competitive position. Major word processing vendors have recently been issuing updated versions of their programs on an accelerated basis, with new versions appearing annually or even semiannually.

Fifth as Waterson earlier noted, this type of protection is likely to produce substantial product variation and to provides incentives to authors to upgrade products during the life of the IPR. In the early phases of an industry, this type of protection is likely to be particularly beneficial, as it prevents consumer "lock-in" on a early (but perhaps flawed) product by encouraging the development of close substitutes. Patents, with their broader protection, are more likely to encourage premature lock-in on software application programs. 7

As our analysis above shows, positive transaction costs are important determinants of the choice of property rights institutions. In a zero transaction cost world, intellectual property rights would be fully defined and fully enforced. In our positive transaction cost world, use of copyright law to protect computer software is warranted because it reduces the costs associated with defining, tracing, and enforcing IPRs in software. While our analysis is too narrow to consider the efficiency of a new sui generis property rights structure
for computer software, it does shed light on why other types of existing IPRs are unlikely to be constrained efficient with respect to software.

III. VARIATIONS IN INTELLECTUAL PROPERTY RIGHTS ACROSS COUNTRIES

The usual property rights analysis must be modified when we consider an open rather than a closed economy. The costs and benefits produced from intellectual property rights in one country often spill over to other countries. This means that while the overall world economy gains from properly specified intellectual property rights, some countries lose. Conflicts between countries concerning the type and strength of IPRs should be expected. Countries differ in their relative supplies of and demands for creative works as well as their enforcement costs and legal institutions. The optimal set of incomplete rights establishing intellectual property should vary across countries according to the variables listed above. Despite these differences most developed and many developing countries are bound by a set of international agreements which aim to coordinate and standardize IPRs across countries.

The Berne Convention establishes national treatment; it allows for copyrights to be established without formal registration procedures; and it sets certain minimum standards for each signatory's copyright laws. The United States and Japan are also signatories to the 1952 Universal Copyright Convention (UCC) which is administered by UNESCO—an agency of the United Nations from which the United States has withdrawn. The multilateral agreements suffer from two deficiencies. They have no mechanism to remedy disputes and either have no standards or only very minimal standards of property right delineation and enforcement. The equal treatment provisions allow foreigners to have access to a nation's courts, but this may not prove particularly valuable if the court system in the foreign country works poorly or if the nation's statutes provide
only weak protection for intellectual property. The procedures reducing the transaction costs associated with patents and copyright applications in foreign countries are, however, certainly beneficial and should not be overlooked. International agreements of this type are useful in coordinating relationships between well-functioning systems of intellectual property protection, but they do not provide incentives for small developing countries to strengthen their protection of intellectual property rights.

Small (i.e., poor) economies often have fewer incentives than large economies to establish intellectual property rights in software. Most small economies run a trade deficit in computer software, importing more than they export. This often occurs because the small country participates in industries that generate few important software applications and because there are external and internal economies of scale in developing software. Scale economies lead to R&D activities being located in a large economy, as there are often complementarities between software R&D and the number and variety of software production facilities.

Countries that are net importers of software will benefit from establishing weaker IPRs in software. They will benefit from "free-riding" on foreign software if (1) the country has a low ratio of exports to output (thereby reducing the potential for retaliation); (2) the countries from which it appropriates software purchase only a small percentage of its exports (thus reducing losses from retaliation); and (3) domestic R&D activity is small. If domestic innovating activity is nonexistent and is not expected to reach substantial levels in the short term, then weak IPRs will enable the country to free-ride on foreign software without bearing the cost of reduced domestic R&D. When the country reaches the stage in which R&D in software becomes feasible, then IPRs in
computer software can be introduced (Kawaura, 1989). More generally, small economies that are net importers of technology will find it profitable to establish more restricted IPRs than those established in large economies. The term of protection which maximizes benefits to the small country's citizens will be shorter than the term which maximizes benefits in the large economy.\textsuperscript{12} The optimal rate for the world economy lies between the two rates: this is due to the reduced attention paid by the small economy to the world innovation rate (as it is a net importer of innovations) and to the reduced attention paid by the large economy to the effects imposed on consumers in the small economy from the longer protection period (as it is a net exporter of innovations).\textsuperscript{13}

The term for a copyright is the life of the author plus 50 years. From the perspective of a user of computer software, this is effectively an infinite horizon. The long term is, however, somewhat of a moot issue, as most software programs do not have a commercial life beyond 10-20 years. Nonetheless, the scales seem to be tilted towards new invention. One interpretation is that the system is skewed toward exporters of software, such as Japan and the United States. Certainly the long term of copyright protection may ultimately provide a substantial stream of rents for software authors in developed countries who develop fundamentally new programs that are costly to replicate or produce a lock-in effect.

Yet use of the copyright law to protect computer software has not been heavily resisted by developing countries. They have instead focused their protests on the product patent system, particularly objecting to intellectual property rights in pharmaceuticals. One reason why copyright in computer software may have been more readily accepted is due to the narrow protection offered by copyright law. Narrow protection reduces the monopoly premium that a developing
country pays for the product. Since copyright law encourages the development of close substitutes, it is relatively low cost for domestic industries, at some stage in their development, to develop competing substitute products. In many ways, copyright law provides protection that is similar to process protection for pharmaceuticals in patent law: It provides some protection to the inventor, but less protection than product patents. This is because imitators generally find it less costly to develop a substitute process of production than a substitute product.14

In sum, the Japan-U.S. copyright standard is likely to provide a reasonable international standard for IPRs in computer software. While the term of protection is too long, the narrow band of protection encourages competition from firms in developing nations while providing some protection to existing producers in developed countries. True coordination across countries is, however, a standard that is unachievable. Highly varying costs of enforcement, different transaction costs, and different demands for product variety across countries mean that the common framework will translate into different results in different countries. Nonetheless, use of the copyright standard in conjunction with the Berne Convention appears to provide a workable standard for IPRs across developed and developing nations.
REFERENCES


FOOTNOTES

1. Property rights in software are occasionally established by trade secret and patent law.

2. Registration in the U.S. makes it easier for an author to recover damages when the copyright is violated.


4. Suppose the provider of the invention is compensated by a fixed fee and/or royalty paid by the state while users of the invention pay a zero price. The additional taxes imposed to compensate the inventor generate deadweight losses. Efficient taxes are set to maximize the gains from new product development minus the deadweight losses from the tax. This system restricts property rights in inventions by reducing payments to inventors to limit the deadweight loss from taxation. A user charge generates deadweight losses due to restricted use of the product.

5. See Arnott and Stiglitz (1986) for a discussion and application of the concept of constrained efficiency.

6. As more consumers copy a given computer program, the value of the original copies sold in the market increases. If the owners of the original copies are able to charge for the additional copies, then these legal buyers will be willing to pay a higher price to the software company. If the owner is unable to collect payment for the copies, then the buyer will be unwilling to pay a higher price. See Swan (1980) for a full discussion of these issues.

7. Menell (1987) has correctly argued that copyright is less advantageous in protecting computer operating systems due to network externalities and to the ability of dominant companies to produce close substitutes for new operating systems.

8. See La Croix (1991) for an extended treatment of intellectual property in developing countries.


10. See Penrose (1951) for an early statement of this view.


13. Both parties will consider the effect on their own welfare rather than on the parties' joint welfare.
