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An Economic Analysis of Computer Software Copyright: A Welfare Model of Intellectual Property Rights, 11 Computer L.J. 173 (1991)

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NOTE

AN ECONOMIC ANALYSIS OF COMPUTER SOFTWARE COPYRIGHT: A WELFARE MODEL OF INTELLECTUAL PROPERTY RIGHTS

I. INTRODUCTION

Computer software defies the traditional categorizations of intellectual property media. At times it is a scientific innovation. At other times, often at the same time, software is a creative work of expression. More important, the advancements in computer art, computerized/digitized music, and other multi-media areas will muddle those distinctions even more.

It is no wonder that courts have struggled to develop this area of the law. Analogy-based arguments are only useful if we have good analogies. In essence, courts are driving forward while looking in the rear-view mirror. The historical perspective (the rear-view mirror) is most useful if we are traveling on a familiar street. If we are traveling in unchartered territory, a rear-view mirror is less useful.

This is not to say that we cannot find our way using the rear-view mirror. We can, by trial and error, chart a new map of the unexplored territory. The courts have done this for the past thirty years. Unfortunately, technology is advancing far faster than the courts, and we face the prospect that new doctrines may be obsolete before they are fully developed.

This Note analyzes the extent to which computer software should be afforded copyright protection. The issue is addressed from a prospective point-of-view, unbound by legal precedent. It does not ignore history, but keeps it in perspective. The approach this Note takes is different from previous papers. Most legal papers argue that existing doctrines (developed by various courts) are either proper or improper. For the most part, this paper ignores these doctrines until the theory and model are developed. Only then does this paper discuss whether existing doctrines match the developed theory and model. On the other

hand, most economic papers argue whether the existing statutes are optimal (e.g., optimal patent life). This Note takes the statute as given. Instead it looks at the other aspect of our common law legal system, the actions taken by judges. Hence, this paper is concerned with defining the optimal behavior of judges (as opposed to legislators).

Section II addresses the basic question of why intellectual property should receive protection at all. At first glance, the answer is obvious—"[t]o promote the progress of science and useful arts. . . ."[1] However, this answer presupposes a more basic question—why do we need to promote the useful arts and sciences? Section II discusses the failure of traditional arguments to satisfactorily explain the need to protect intellectual property, and Section III discusses the economic theories behind intellectual property protection.

After the normative framework is complete, a theory must be developed on how to reach our normative objective. That is, how should we accomplish our goal and what factors have an impact on our objective? Section IV discusses the different modes of achieving this goal. Section V discusses the appropriate breadth of protection from an economic standpoint, and Section VI attempts to point out the major factors that impact our analysis.

Once the theoretical framework is developed, Section VII attempts to develop a workable model which policymakers and judges can use. Since we have limited human capacities, we need to develop a model that will help us decide a proper course-of-action, based on limited information. Section VIII compares the legal doctrine to the developed model.

Section IX points out that the international dimensions of copyright need to be considered, and therefore warrant further discussion.

II. WHY HAVE INTELLECTUAL PROPERTY PROTECTION?

The Constitution specifically gives Congress the power to pass laws ". . . to promote the progress of science and the useful arts . . . ."[2] Therefore, the law should protect computer software as long as such protection promotes the useful arts and science. However, as stated above, there is a deeper question of why we need to specially protect this type of activity. Analyzing this question may reveal a deeper normative goal. This section concludes that traditional views have not adequately addressed the question of the breadth of rights and that economic views may have a better explanation.

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1. U.S. CONST. art. I, § 8, cl. 8.

2. *Id.*

A. TRADITIONAL VIEWS

Most of the legal literature treats intellectual property rights in the same way as it treats other property rights.[3] Property rights are seen from the perspective of the moral rights of the individual.

1. *Labor Theory*

Generally, labor theory tells us that the inventor or author should receive the fruits of his work.[4] In a sense, this paper presumes that this right exists (e.g., in litigation, someone has a patent or copyright). Conversely, labor theory does not clearly offer a way to determine the breadth of this right (e.g., how broad is the patent or copyright protection).[5]

Moreover, this theory does not explain why work product from authors and inventors is different from other types of labor.[6] Even if we presume that there is something different about creators, it is not clear that the mere expense of labor is a good reason to award intellectual property rights.[7]

2. *Personality Theory*

Personality theory tells us that property rights exist because the creation is an expression of the creator.[8] Therefore, a violation of the property is like a violation of the person. Again, this paper presumes that there is a general right; the question is how broad the right should be.[9] In addition, as with labor theory, personality theory may not explain why there is a need for a separate system of protection for this type of property.[10]

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3. For a discussion of traditional arguments see Hughes, *The Philosophy of Intellectual Property*, 77 GEO. L.J. 287 (1988).

4. *See generally id.* at 296-330. Hughes outlines a basic labor theory argument.

5. *See generally* Breyer, *The Uneasy Case for Copyright: A Study of Copyright in Books, Photocopies, and Computer Programs*, 84 HARV. L. REV. 281, 284-91 (1970). Breyer argues that traditional arguments for intellectual property are not very strong.

6. *See generally id.* at 285-86. Breyer questions whether traditional views can explain why intellectual property cannot be protected through general means, i.e., property law, contract law, tort, etc.

7. *See generally id.* at 288-89 and n.29. Breyer asks the question "Why?" in reference to the Lockean view. Breyer argues that with conventional property there is a congestion problem, i.e., only one person can have the property at a time. This is not necessary with intellectual property.

8. *See generally* Hughes, *supra* note 3, at 330-66. Hughes outlines a basic personality theory argument.

9. *See generally* Breyer, *supra* note 5, at 284-91. Breyer argues that traditional arguments do not present a convincing argument for intellectual property.

10. *See generally id.* at 289-91. Breyer argues that the traditional views have not presented a convincing argument for why a separate system is required.

Personality theory may help answer another question—what are a creator's "moral" rights (e.g., even after selling some of the rights, should the creator's name be on any publication?). However, the question of moral rights is beyond the scope of this paper.[11]

3. *Summary*

While traditional views can tell us when a grant of rights should exist, they do not directly address the question of how broad these rights should be.[12]

B. ECONOMIC VIEW

An economic perspective (possibly a liberal economic perspective) is from the society as a whole, rather than from the specific moral rights of the individual. Generally, the economic view proposes that the government does not protect property rights merely to protect individual moral rights. Instead, the government protects property rights to maximize the welfare of society as a whole. The government should reward the individual creator with the rights which maximize social welfare.[13]

Therefore, economics provides a theoretical framework to answer the two questions that the labor theory and personality theory could not:

(1) Does intellectual property warrant special protection? Yes, if protection maximizes social welfare.
(2) How broad should protection be? Broad enough to maximize social welfare.

III. AN ECONOMIC VIEW: WHY HAVE PROTECTION AT ALL?

From an economic standpoint, the only reason to intervene[14] in the market is to correct a market failure. The justification most often cited is the public goods (positive externalities) problem.[15] Generally, the producer of the good has no way to exclude others from enjoying the benefits of his production and has no effective way of charging others

11. This paper focuses on the economic rights, i.e., the ability to exact financial rewards.

12. An in-depth argument is beyond the scope of this paper. For a more detailed discussion, see Hughes, *supra* note 3 and Breyer, *supra* note 5.

13. This is, of course, a simplification. It views the individuals in government as working in the interest of all of society rather than working in their own self-interest.

14. "Intervene" is meant to mean any economic regulatory process. It does not necessarily refer to any political inferences.

15. *See, e.g.*, Menell, *An Analysis of the Scope of Copyright Protection for Application Programs*, 41 STAN. L. REV. 1045, 1058-66 (1989); W. NORDHAUS, INVENTION, GROWTH, AND WELFARE 35-59 (1969).

for the use. Since the producer faces all the cost and only a small portion of the benefit, he will tend to underproduce the good.

With software, if everyone could copy a creator's product (presumably at a low cost), very few people would buy the original. Just as in the public goods case, the creator has faced the entire burden of production but has received only a small portion of the benefit (from the few originals that sold). Therefore, the creator will tend to underproduce.

A slightly more sophisticated explanation is that the creator faces both fixed and variable costs, while a challenger only faces variable costs. At competitive prices, where price equals the low average costs of competitors, the creator will have to price below his cost and therefore lose money.

With other economic activities, this bidding process is important since only the efficient producers will stay in business. The market will bid out inefficient producers. This generally means that consumers receive more goods at a lower price (in a purely competitive model) and hence, the economy as a whole is better off. However, with intellectual property, if the creator does not produce, obviously no one else will be able to copy. While the economy gains by the elimination of inefficient producers, it also loses the entire benefit of production.

If the gross benefit from an innovation (including positive externalities) is larger than the total costs, the economy is better off if the creator produces. Since, as stated above, the individual agent has a disincentive to produce (the market failure), society must subsidize the creator to overcome this disincentive (assuming society's goal is to maximize aggregate welfare). Copyright protection is one type of subsidy. It allows the holder to exact monopoly rents, thereby increasing the creator's incentive to innovate (or lessening the disincentive to innovate).

IV. WHAT FORM SHOULD THE SUBSIDY TAKE?

There is more than one way to give innovators incentives to innovate. Moreover, at present, the government uses more than one method to provide incentives, the most important probably being direct research grants.[16]

While the issue of form is not directly related to how broad the grant should be, it is useful in determining how to reconcile practice with theory. In other words, our use of a copyright (or patent) system is the root cause of some of the difficulties of reconciling theory and practice. For example, if our goal is to give the innovator a reward (presumably financial), the government could merely give the innovator an

16. For a discussion of some of these alternatives and their economic impact see Wright, *The Economics of Invention Incentives: Patents, Prizes and Research Contracts*, 73 AM. ECON. REV. 691 (1983).

ex post reward.[17] This way, there is no underproduction, since the innovator has an incentive to produce. Moreover, since the government (after quasi-purchasing the copyright or patent) can now release the technology for public use; the use of the technology is maximized.

There may be an argument that research grants are a form of ex ante payment. However, ex post rewards are not widely used, with the possible exception of technology directly consumed by the government. The reason for this is obvious. How is the government to determine these values? First, it would be difficult for anyone (including economists) to precisely measure the future value of an innovation (although it can be estimated). Second, it is even less likely a government body that is unfamiliar with economics, finance, the market for the product, and the technology involved will be able to accurately place a value on the technology.[18] Third, it is unlikely that this government body will have an incentive to accurately value these innovations, since politician's personal incentives lie elsewhere.[19]

We have therefore settled on a system of granting monopoly rights. This way, by selecting what to produce and consume, producers and consumers can determine the value of the product. Even though this does not theoretically maximize social welfare, this may be the most efficient manner possible. In other words, this mechanism maximizes welfare when compared to other social mechanisms.

This monopoly, however, causes distortions that make policy decisionmaking difficult. The general consequence of monopoly power is that the producer will limit the quantity produced and thus raise the price. This creates a paradox—there is more technology for society, but fewer members of society can use the new technology (since it is monopolized by the producer). This problem is called the problem of "underutilization."

The problem with copyright protection is finding a balance between underproduction and underutilization.[20] In other words, we need to weigh the benefits of more technology versus the loss from less users having access to the technology (since access is legally restricted). This issue is discussed in-depth in Section VI.

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17. I.e., the government would pay the innovator for the value of the innovation after the innovation is complete.

18. Although this is somewhat circular, if the court says it is worth a certain amount and enforces that value, then innovators will only place that value on the innovation. However, the main point is that innovators, have an asymmetrical information advantage. *See* Wright, *supra* note 16.

19. For example, a legislator's incentive may be to lobby for a constituent rather than society-at-large.

20. A number of papers have addressed this issue. *See, e.g.*, Novos & Waldman, *The Effects of Increase Copyright Protection: An Analytic Approach*, 92 J. POL. ECON. 326 (1984); Johnson, *The Economics of Copying*, 93 J. POL. ECON. 158 (1985).

V. AN ECONOMIC THEORY: HOW BROAD SHOULD PROTECTION BE?

The granting of a copyright can have three possible effects on social welfare: it can increase social welfare, decrease social welfare, or leave social welfare relatively unchanged. Thus, in theory, the decision whether to grant a copyright is simple. If we were to line these cases in order of the net benefit to society, we would award rights to those creators that have innovations with a societal benefit greater than zero. This way we maximize social welfare.

Unfortunately, as with traditional arguments, this only tells us if the grant should be made. It does not address the primary question of how broad the protection should be.

To answer this question, we must consider the individual incentives. We want to give the innovator the incentive to invest in all projects with a positive net societal benefit. Therefore, we want the innovator to invest in a project up to the point where the marginal value to society is equal to the marginal cost to society. If we underreward, the innovator will underinvest and some projects with positive net benefits to society will not be completed. Conversely, if we overreward, the innovator will overinvest and some projects with negative net benefits to society will be produced, and resources will be wasted.

The goal of software copyright law, therefore, is to award the innovator a right that is equal to the software's marginal value to society. This way, the innovator has the incentive to optimize social welfare.[21]

One problem with this normative theory arises when the individual benefit is so large (and therefore the societal benefit is so large) that the innovator would have completed the project even without protection (and the costs associated with it).[22] Our theory would give the innovator a strong grant even though it would be unnecessary.

A simple assumption can eliminate this paradox — the existence of competition for these grants.[23] A large "abnormal" return[24] will attract

21. Note that this is not true with grants. Investment is directed by the government, which may not be efficient. *See* Wright, *supra* note 16, at 691.

22. Basically, demand would out poll supply by a significant enough margin that the market price remains high enough for the innovation to make an economic profit.

23. *See generally*, Kamien & Schwartz, *Patent Life and R&D Rivalry*, 64 AM. ECON. REV. 183 (1974); DeBrock, *Market Structure, Innovation, and Optimal Patent Life*, 28 J. L. & ECON. 223 (1985). Both articles present the concept of competition for innovation.

24. An abnormal return is a return that is consistently (as opposed to randomly) above or below a normal rate of return. A normal return is a "fair" rate of return. The term "fair" does not have any legal or philosophical connotation. Instead it refers to the rate of return necessary for the investor to keep his investment in place (considering the risk of the project).

other innovators who would compete away the "abnormal" return.[25] For example, this competition can be the result of: (1) price competition with final products; (2) competition over the cost of resources such as scientists, laboratories, etc.; or (3) competition over the costs associated with obtaining and protecting the grant, such as lawyers' fees. Hence, the existence of competition tends to bid away this problem.[26]

Copyright protection should be broad enough for the producer to recover the net value created. In a perfect world, this might be the market value. Unfortunately, the market value (i.e., the price at which you could sell the copyright) is dependent on how broad a protection the copyright is awarded by the courts. This creates a circularity problem. Therefore, the courts must develop some way to measure a copyright's value that is independent of the court's decision.

VI. AN APPROACH TO THE VALUE OF A COPYRIGHT

A. THE IMPACT OF THE INNOVATION (MAGNITUDE)

As stated above, the question is how to place a societal value on an innovation. The most obvious first criterion is how much impact the innovation will have on society (or has had, since courts have the advantage of hindsight). Is the innovation of use to a wide variety of people or only a few? Do these users value the product highly or very little? These questions are an attempt to find an approximate price and quantity of the innovation. In this case, price refers to the breadth of the protection, i.e., the ability to maximize the financial rewards.[27] The broader the protection the higher the price.

Once this approximation is made, we realize that this is only a rough estimate. The question then becomes whether it is better to err high or low? This brings us back to the problem of underproduction versus underutilization.

B. UNDERPRODUCTION V. UNDERUTILIZATION

As stated above, the problem of underproduction is that the innovator will underproduce if not given enough incentive. Therefore, society as a whole is worse off.

On the other hand, the award of a monopoly right over the innovation creates other problems. The creator has an incentive to restrict

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25. *See* DeBrock, *supra* note 23, at 241.

26. Again, this may not occur with grants. Profitability is dependent on government action. *See generally* Wright, *supra* note 16, at 691.

27. In most industries the decision to produce is dependent on the economic value the producer will receive, i.e., the price. Similarly, the innovator's decision to produce is dependent on the ability to exact economic value. Here, the behavioral function is the same as price in a general model.

supply and charge a higher price. In addition, to a certain degree, the monopoly right restricts the free flow of information which may lead to later advancements. Both of these problems are costs of underutilization.

The most difficult question with regard to copyright (or patent), therefore, is how to balance the problem of underproduction with the problem of underutilization.

In economic terms, the most important issue is the relative relationship of the elasticities of supply and demand. In other words, if the supply of innovation is fixed, increasing or decreasing protection will have no impact on supply (i.e., no underproduction).[28] Conversely, if demand is fixed, a change in protection will have no impact on demand (i.e., no underutilization).[29] Of course, supply and demand are usually neither fixed nor totally elastic. Therefore, the relative relationship of the elasticities will determine whether the relative cost of underproduction or underutilization is greater.

Ceteris paribus, it would be better to err towards strong protection when the supply is relatively elastic and the demand is relatively inelastic. Conversely, it would be better to err towards less protection when the supply is relatively inelastic and demand is relatively elastic.

1. *Demand*

The primary factor affecting demand (for our purposes) is the availability of substitutes (competition).

a. Direct Competition

While the above arguments have implicitly assumed a true monopoly, in reality, most software is in a market of monopolistic competition. That is, while the producer has a monopoly over his product, there may be substantially similar (but different) products competing for the same market.[30] If this is the case, demand is more elastic. This monopolistic competition therefore acts as a mitigator against underutilization.[31]

Hence, the greater the availability of substitute products, the better it is to err on the side of the producer. Therefore, ceteris paribus, the copyright protection should be broader.

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28. In other words, if supply is fixed, the producer will not change the quantity produced if the price is less.

29. Similarly, if demand is fixed, the quantity concerned is unaltered by a change in price.

30. Unfortunately, this argument is circular. How substantially similar a competing product is depends on the degree of protection given by the courts.

31. Forced to lower prices in order to compete, the producer must raise production to be profitable.

b. Copies as Substitutes

The market for copies also acts as a type of competition. If prices are high enough to overcome the cost of copying and the loss of quality,[32] consumers will tend to opt for copies instead of originals.[33] This also acts to make demand more elastic and mitigate underutilization. Of course, this is the primary cause of underproduction. There are, however, other factors that can mitigate underproduction.

i. The Degree of Exclusion

As stated above, the general theory behind underproduction is the concept of public goods. However, unlike the pure public goods model, software is not totally nonexcludable. The innovator can create the product and only use it himself or he can limit distribution to only a few users through private contract.

Other papers have developed the term "partial nonexcludability" to describe software.[34] While the creator can try to limit distribution, at some point direct control becomes limited. Someone with a strong enough desire can appropriate an original and make a copy. Hence, even without true nonexcludability, there is still a problem of underproduction.

From the producer's viewpoint, the extent of underproduction is dependent on the extent to which producers can exclude copiers from the market. For example, for specialized commercial software, the relatively small number of users may allow the producer to control the distribution of the software. Since the producer is able to realize full profit potential, there is less problem with underproduction. On the other hand, for mass production software, the producer may not be able to control copying. Hence, underproduction may be more acute.

Conversely, for users, a high degree of control by the producer translates into increased monopoly control. The cost of underutilization will therefore probably be higher for specialized software. On the other hand, the easier access to mass production software mitigates the cost of underutilization. The user will merely purchase a copy.

The producer can also attempt to limit copying by use of warranties and technical support. Presumably, a producer will not replace or support an illegal copy. Hence, the need for service acts to mitigate copying.

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32. *See infra* text accompanying notes 39-42.

33. Unfortunately, this is also circular. This competition is dependent on the court's grant of damages (a cost of copying) and the ability to enforce anti-copying laws (e.g., it may be relatively easy to control copying of specialized software, but not for video games).

34. *See, e.g.*, Novos & Waldman, *supra* note 20. Nordhaus refers to this as "partial appropriability." *See* NORDHAUS, *supra* note 15, at 35-39.

It should be noted that application software (e.g., wordprocessors, spreadsheets, etc.) is generally not copy-protected and has a higher price. One argument for this might be that the necessity of quality and the desire for technical support are important factors in purchasing the good. On the other hand, games are always copy-protected even though they sell at a very low price. This suggests that quality and technical support are not an integral part of the program.[35]

If the producer is successful in excluding illegal users, then the cost of underutilization becomes very high. However, the ability to contract privately may also act as a mitigator. Several papers have offered a Coasean analysis[36] of the underproduction/underutilization debate. If the two parties, producer and consumer, have the ability to negotiate, they will privately contract to minimize costs from underproduction and underutilization.[37] The ability to negotiate (small transactions costs) mitigates the need to protect the consumer. Therefore, it is generally better to err in favor of the producer, unless the producer has a high degree of control and there is no opportunity for direct negotiation.[38]

ii. The Cost of Copying

Unlike the pure public good model, copying may not be costless.[39] As opposed to the illumination from a street light, the "free rider" must obtain access to an original and make a copy. High copying costs can mitigate the loss from underproduction. If distribution is limited, copying may be costly. Conversely, if distribution is very wide, copying may be inexpensive.

The pure public good model also does not reflect a difference in quality.[40] While illumination from a street light may have no gradation of quality, software and other recorded media can have a clear gradation in quality; e.g., bugs and/or problems in "unlocking" the original. If the quality of the product is essential, consumers will opt for originals and the loss from underproduction is mitigated.

Losses from underproduction may therefore not be as drastic as with a pure public good. If copying costs are relatively high and the

35. This may also partially explain the amusing number of cases involving video games.

36. Coase, *The Nature of the Firm*, 4 ECONOMICA 386 (1937); Coase, *The Problem of Social Cost*, 3 J. L. & ECON. 1 (1960).

37. *See, e.g.*, Yu, *Potential Competition and Contracting in Innovation*, 24 J. L. & ECON. 215 (1981).

38. This theory would predict that for limited distribution software, private contract would be more prevalent. *See generally id.*

39. *See* Johnson, *supra* note 20, at 166-70.

40. *See generally id.* at 170-71.

copy quality is relatively low, many consumers may opt to buy an original even if copying was legal.[41] If, on the other hand, copying costs are low and the difference in quality is low, the cost of underproduction will be high.[42]

2. *Supply*

If supply is fixed, the loss from underproduction is zero. Conversely, if supply is totally elastic, then the loss from underproduction is infinite.

Some types of research are less sensitive to financial rewards than others. There is a wide range of types of research, from the most fundamental of scientific experiments to the actual product offered to the consumer. For simplicity, however, this paper divides research into two groups: basic research and applied research. The difference is that basic research has no direct commercial impact. It either leads to applied research or more basic research. In contrast, applied research leads to a direct commercial benefit.

Basic research is not as sensitive to economic rewards (i.e., a patent or copyright) as applied research. This is not to say that basic research is totally insensitive to financial factors, but the direct value of selling the innovation is not clear.[43] Therefore, copyright protection is generally unnecessary.

There is another reason for not protecting basic research. With applied research, there are usually many different ways to accomplish the intended goal. Substantially different products can do the same tasks. However, with basic research, two researchers doing the same experiment, are bound to end up with similar results. Therefore, if the innovation is similar to basic research, there may be a production benefit from copying—future innovators will be free to make the next advancement. Conversely, restricting access to basic research will unduly burden future advancements.

3. *Standardization and the Network Paradox*

The issue of standardization is similar to the copying problem discussed above. Copying can have positive effects. For example, if meth-

41. For example, the movie industry originally lobbied to restrict copying using VCR tapes. They claimed that copying would eliminate their market. However, in hindsight, home video has proven to be a huge market for the movie industry (but with a substantial reduction in per unit price).

42. For example, DAT may differ from the previous VCR example in that a DAT copy is "exactly" like the original. At least, the gradation in quality is theoretically less with DAT than with VCR.

43. Financial incentives to create basic research tend to take a form other than intellectual property protection, i.e., grants.

ods of operations are allowed to be copied, users will be able to learn different software more quickly.[44] Menell refers to this as a "network externality."[45]

Networks are unique because they display a peculiar supply and demand. For example, consider the telephone system. A system with only one user has very little value. At the other extreme, a telephone system that can reach everyone is the most valuable; not only in the aggregate, but to each individual user as well.[46] As a result, we have a peculiar demand function which is upward sloping—the greater the quantity sold, the greater the value to the user, and therefore the higher the price the user is willing to pay.

On the supply side, large fixed costs and relatively small variable costs create a relatively downward sloping supply curve (marginal cost curve). Hence, supply and demand have the opposite characteristics as normally expected and the optimal quantity at equilibrium is infinite.[47]

Therefore, restricting the use of network standardizations will lower welfare. If the innovation is a type of standardization (or basic research), it is better to err in favor of the users.

VII. MEASURING SOCIAL VALUE FOR SOFTWARE

A. VALUE OF THE INNOVATION - MAGNITUDE ("M")

The key issue is the approximate value of the innovation. Nordhaus refers to this value as the societal importance of the innovation,[48] which is similar to the patent concept of a significant non-obvious step.[49]

This paper divides magnitude into two separate components: (1) the vertical leap, and (2) the horizontal leap.

1. *Vertical Leap ("V")*

The vertical leap ("V") is defined as the extent to which an innovation improves upon the existing technology. The greater the V, the greater the value created to society. Hence, an innovation with a large

44. For example, the icon driven interface of most Macintosh software, or using the "F1" key for help.

45. Menell, *supra* note 15, at 1066-71.

46. This is a simplifying assumption. There may be at least one consumer who places little value on being able to call anyone outside of a small group of people.

47. This is an enormous oversimplification. Eventually, marginal costs will rise and marginal revenue (from each new phone) will begin to decline. However, it is important to note this peculiar relationship.

48. *See* NORDHAUS, *supra* note 15.

49. This may also be similar to the copyright concept of originality. However, a technological step may imply a large degree of copying (i.e., building on others innovations). Therefore, the patent concept is more useful.

V should be widely protected whereas an innovation with a small V merits narrower protection.

2. *Horizontal Leap ("H")*

The horizontal leap ("H") measures the extent to which an innovation has been created "ahead of its time." An innovation that would not otherwise have been created for a substantial length of time would have a high H. The larger the H, the broader the protection should be. H is related to V, but it may not be the same. For example, if there are several firms attempting to discover the same innovation, then H may be small irrespective of how large V may be. Alternatively, H may be very large while V is relatively small if there is a profound but incremental discovery.

Measuring H poses a difficult problem. However, courts have the advantage of hindsight. The court is faced with an affirmative challenger and therefore has a benchmark on the size of H. The court's inquiry only needs to determine whether the challenger's discovery was an independent process (and therefore a true measure of H) or whether it was partially supported by the creator's original discovery, in which case H is actually larger.

B. MARKET FACTORS - ELASTICITIES ("E")

As stated above, the relative elasticities of supply and demand are important in that they help to determine whether it is better to err on the side of the producer or the consumer. The following are several factors which may help a court to approximate the proper result.

1. *Distribution ("D")*

For simplicity, this paper will divide the potential products into mass distribution and limited distribution.

Mass distribution software implies a greater likelihood of direct competition. If the market is large enough for mass distribution, then substitute competition is bound to follow. This lessens the problem of underutilization. The opposite is true for limited distribution software.

In addition, the degree of exclusion and the cost of obtaining an original for copying can be presumed to be lower with mass distribution software. Therefore, the availability of copies results in a lower cost of underutilization. Again, the opposite is true for limited distribution. Also, even if the product has limited distribution, the loss from underutilization may be minimized by direct negotiation.

Therefore, if there is a high degree of control over distribution by the producer and there is no ability to directly negotiate, it is better to

err on the side of the consumer. In any other case, it is better to err on the side of the producer.

2. *The Type of Software ("S")*

If the product is the type of software which requires a high degree of technical support or warranty protection, the control by the producer is greater, and the conclusion is the same as limited distribution software. The opposite is true for software that does not require warranties or technical support.

Likewise, if gradations in quality are an important consideration (as they might be for the same type of software requiring technical support and warranty protection), then greater control by the producer will minimize the loss from underproduction (similar to limited distribution software). If gradation in quality is not important, the opposite is true.

Therefore, if the software is the type of product that requires a high degree of technical support or quality, it would be better to err on the side of the consumer. Otherwise it would be better to err in favor of the producer.

3. *Type of Innovation ("T")*

As stated above, basic research is less sensitive to commercial rewards (such as copyright) than applied research. Since there is less loss from underproduction, basic research should receive little copyright protection.

Software packages are not easily defined as basic research. However, if we soften the characterizations, we can see that there may be some programs that are more analogous to basic research than others.

Again, basic research is research that is the foundation for greater research. Thus, if the software innovation can lead to newer and better innovations (e.g., algorithms, programming languages, macros, etc.), the protection should be more limited since a large loss would result from underutilization. However, if the software is purely an end product (e.g., video games), then a lower loss would result from underproduction, and the protection can be very strong.

There is a paradox with this concept. The same innovations we do not want to protect because of T may be the very same research that has a high V and H. However, T is assumed to be independent of V and H. That is, T is the value created by future innovations, as opposed to the value created by the current innovation. V and H are advances above the related T value.

The concept of standardization also falls into this category. The value of the standard is the ability for everyone to use it. Therefore,

restricting the use of a standard reduces welfare. If the innovation can be considered a standardization, then protection should be less.

C. Other Considerations

1. *Use*

Use is not a true factor, but it is still important in determining the social value of an innovation. Generally, the creator must use the product in order to receive protection. For example, a patent award has little social value if the inventor decides to shelve the discovery, and thus, there is no compelling reason to protect the discovery. Also, the problem of copying is non-existent if the idea is not offered to the "pool of knowledge."

Use is of less importance with software than with patents. Unlike some patent inventions which occur by chance, software developments never occur by chance. In order to receive a copyright, the software developer must have spent time and money writing the program. We can presume that the producer wrote the program for an intended use and not merely to shelve the innovation.

2. *Costs Are Irrelevant*

In direct contradiction with labor theory, the expenditures made on research have no direct impact on the value created to society. For the same reason that labor theory fails in determining the value of tangible property,[50] labor theory fails to determine the value for intellectual property.

Moreover, if the grant of rights is a primary incentive to expend research costs, granting rights based on expenditures creates a circularity problem. In other words, a researcher allocates his research funds based on the likelihood of receiving copyright protection. It would be circular if, at the same time, the court were to grant protection based on the amount of funds the researcher had allocated to this project.

3. *The True Market*

In measuring the welfare loss from underproduction, it is important to note that the producer loses only if the consumer would have otherwise purchased an original instead of a copy.[51] If this is not true, there is no underproduction loss, since the sale would not have been made at

50. For example, the extent of labor expended on two identical widgets does not determine their price (value). Even if one widget took twice as long to make, it will not be worth twice as much as its identical counterpart.

51. *See* Johnson, *supra* note 20, at 172.

the higher monopoly price. On the other hand, there is a gain from greater utilization from the copying.

VIII. APPLICATION OF THE MODEL

A. THE LEGAL DOCTRINE

To prove copyright infringement, the plaintiff must prove (1) that he possesses a valid copyright, and (2) the defendant copied the plaintiff's work.

1. *Valid Copyright - Copyrightability*

Generally, the critical issue is not whether a copyright exists, but whether the work is copyrightable. For a work to be copyrightable it must be an "original work of authorship fixed in any tangible medium of expression."[52]

Although early cases debated when a computer program is in a tangible medium, this is no longer the case.[53] The current debate has concentrated on the originality of the work. If the work is not original, it is not copyrightable. Only works with at least some degree of originality will be protected.

The courts have also struggled with a second issue. Section 102(b) of the Copyright Act of 1976 states that ideas cannot be copyrighted; only the expressions of those ideas can be protected.[54] Furthermore, when the expression is inseparable from the idea, "protecting the expression in such circumstances would confer a monopoly of the idea upon the copyright owner."[55] Therefore, the courts have ruled that this type of expression is also not copyrightable.

The discussion by various courts on this rule is rather muddled. The rule specifically states that an expression inseparable from its idea cannot be found to be substantially similar, where substantial similarity is a requirement to prove copying.[56] However, the limitation on protecting ideas is not necessarily related to the issue of copying.[57] Even if the work was undeniably copied, this rule states that the work is still

52. Copyright Act of 1976, 17 U.S.C. § 102(a) (1988).

53. *See, e.g.*, Data Cash Sys., Inc. v. JS&A Group, Inc., 480 F. Supp. 1063 (N.D. Ill. 1979); Tandy Corp. v. Personal Micro Computers, Inc., 524 F. Supp. 171 (N.D. Cal. 1981). Much of the problem was eliminated by the Semiconductor Chip Protection Act of 1984, 17 U.S.C. §§ 901-914 (1980). *See also*, Note, *The Semiconductor Chip Protection Act: A New Weapon in the War Against Computer Software Piracy*, 1986 UTAH L. REV. 417 (1986).

54. 17 U.S.C. § 102(b) (1988).

55. Herbert Rosenthal Jewelry Corp. v. Kalpakian, 446 F.2d 738, 742 (9th Cir. 1971).

56. *See infra* text accompanying notes 63-67.

57. Stillman v. Leo Burnett Co., Inc., 720 F. Supp. 1353 (N.D. Ill. 1989) (The court noted the ambiguous and inconsistent use of the term "substantial similarity").

not protected. Therefore, an expression inseparable from its idea is not copyrightable.

2. *Copying*

Since proving copying is often difficult, the courts have created a two-prong test to establish circumstantial evidence of copying: (a) access and (b) substantial similarity.[58]

a. Access

The implication of access is obvious. If the defendant had no access to the plaintiff's program, there could be no copying. Since this is seldom the case, the question arises as to the degree of access. Presumably the greater the degree of access, the greater the circumstantial evidence of copying.[59]

b. Substantial Similarity

For two programs to be substantially similar, they must be "substantially similar in both ideas and expression."[60] To establish this, the ninth circuit has developed another two-pronged test:

> First, an 'extrinsic' test is used to determine whether two ideas are substantially similar. This is an objective test which rests upon specific criteria that can be listed and analyzed. Second, an 'intrinsic' test is used to compare the forms of expression. This is a subjective test which depends on the response of the ordinary reasonable person.[61]

The reason for this requirement is also straightforward. If the works are completely dissimilar there is no copying regardless of the degree of access.

B. THE LEGAL DOCTRINE V. THE MODEL

1. *Originality and Vertical Leap*

As originality is the copyright equal to the patent "significant step," the concept of originality is analogous to vertical leap. The new work must exhibit something new and unique above the existing level of technology.

At first glance, the two concepts have at least one major difference. Originality only goes to whether the work receives protection and is not applicable to the breadth of protection. However, the courts have recog-

58. *See, e.g.* Data E. USA, Inc. v. Epyx, Inc., 862 F.2d 204, 206 (9th Cir. 1988).

59. While this is a logical implication, the writer has not found any cases which explicitly make this statement.

60. *E.g., Data E.*, 862 F.2d at 207; Frybarger v. I.B.M., 812 F.2d 525, 529 (9th Cir. 1987).

61. *Data E.*, 862 F.2d at 208; *see also* Sid & Marty Krofft Television Prods., Inc. v. McDonalds Corp., 562 F.2d 1157, 1164 (9th Cir. 1977) (citation omitted).

nized that the original aspects of a work will be protected, while aspects which are not original will not be protected.[62] In other words, the greater the originality of various aspects of the work, the broader will be the protection. This is not unlike the concept of vertical leap discussed above.

2. *Inseparable Idea and Type of Innovation*

In *Stillman v. Leo Burnett Co., Inc.*[63] the court explicitly states the rational for the inseparable idea rule: "[i]f authors, by publishing their works, could remove the ideas incorporated in them from the public domain, then they could stifle, rather than advance, the development and exploitation of new ideas."[64] Therefore, works which would prevent other innovators from creating should not be protected (or at least receive less protection). This is analogous to the concept of basic research.[65]

A related concept folded into the idea-expression argument is the concept of standards. At least one court has used the idea-expression argument to state that some "copying" may be socially desireable.[66] Restricting the use of "standards" defeats the value of the innovation.

Menell points out that the legal doctrine may be inadequate when dealing with standards.[67] For example, a new type of computer-human interface may be expressed in many ways and therefore not qualify as an expression inseparable from its idea. However, standardization requires exact duplication and copying would create value in this case. Since the copying is "unnecessary," the legal doctrine will rule the use of a standard as a copyright infringement without considering the positive externalities of the copying.

3. *Ideas and Magnitude*

While the legal doctrine states that ideas cannot be copyrighted, the model may award protection. More analogous to patent law, if the magnitude of the new idea is large enough, this gain may offset the burden from the loss of access to the technology.

It is difficult to imagine a circumstance where the idea can be

62. *See, e.g., Data E.*, 862 F.2d at 209.

63. 720 F. Supp. 1353 (N.D. Ill. 1989).

64. *Id.* at 1357.

65. Menell points out a possible shortcoming in the legal doctrine. If there is more than one way to express the idea, but only one "optimal" way, the legal doctrine may award more protection than is proper. Menell, *supra* note 15, at 1084.

66. Synercom Tech v. University Computing Co., 462 F. Supp. 1003, 1013 (N.D. Tex. 1978). *See also* Menell, *supra* note 15, at 1093-1102 (Menell discusses the standardization of human-computer interfaces).

67. Menell, *supra* note 15, at 1098-102.

unique while the expression is not (and thus not otherwise protected), or where the breakthrough idea would not be protected by patent. Regardless, should this occur, the current legal doctrine would not reward the innovator even though it should.

4. *Access and Horizontal Leap*

Since access is generally uncontested, the concept of access is less clear in the case law. To discuss this area, therefore, we will develop our own case scenarios.

Scenario one: two innovators with the same idea independently author similar expressions. There was no specific cause for the similarity, it was mere chance.

In this case, the legal doctrine would award no protection. There was no access and thus no evidence of copying. Implicitly, the doctrine states that if a second author could independently produce a substantially similar product, then the original warrants no protection.

The model would also deny protection. Any value created by the first innovator (i.e., the horizontal leap), was already appropriated by introducing the product first. If the time difference was very large, the first innovator would already have received large monopoly profits. If the time difference was small, then the first innovator only deserved small returns.

Scenario two: same as above, except the second innovator had access to some aspects of the original.

At least one case implies protection only where access is proved. In *Manufacturers Technologies, Inc. v. Cams. Inc.*,[68] the court distinguished between the types of access proved by the plaintiff. Having concluded that the defendant had access to the plaintiff's computer screens, the court allowed the action.[69] However, having found no access to the code, the court ruled that there was no infringement of the code.[70]

As in scenario one, the model would also find that where the development is independent, there is no showing of damages. Conversely, proof of access is circumstantial evidence that the horizontal leap would have been larger had the defendant not had access. In other words, the first innovator is due a larger monopoly return than he received. Moreover, the greater the access, the greater the difference between the rightful monopoly return and the actual return received.

Scenario three: same as above, except the second innovator hears

68. 706 F. Supp. 984, 1000 (D. Conn. 1989).

69. *Id.* at 1000-02.

70. *Id.* at 1002.

about the first innovator's idea, although the second innovator still independently develops the expression.

While the legal doctrine would not award any protection, the model might. If the second innovator would not have been able to create his own work, absent the appropriated knowledge from the first innovator, then some protection may be merited. This unlikely scenario is the same as the unique idea (but not expression) problem discussed above.

5. *Access and Distribution*

While these two principles are different, there is a clear overlap. For example, access to copies or originals is presumably greater for mass distribution software than for limited distribution software. Unfortunately, since the courts have failed to discuss access in much detail, it is impossible to detect whether this type of logic exists in the courts' minds.

There is also an aspect of distribution missing from the concept of access: the aspect of competition. This exposes a large difference between the legal doctrine and the developed model—the legal doctrine does not consider the welfare of non-innovator consumers.

The model was developed to maximize societal welfare. It considers whether the gain to producers outweighs the loss to consumers (hence, the existence of competition is an important consideration since it affects consumers' choices). The legal doctrine has no such normative goal. Instead, following a literal reading of the Constitution, it seeks to maximize innovation. Therefore, the lack of alternative products for the consumer is irrelevant. The logical conclusion of the legal doctrine is that any innovation that does not inhibit future innovation should receive the broadest protection possible. This principle is clearly erroneous, although the cost of this view is clearer with other types of innovations (e.g., pharmaceuticals).

Maximizing innovation is a myopic goal. By creating incentives for innovation, we are actually creating incentives to create value. As stated above, it is counterproductive to destroy this value with overzealous protection.

6. *Substantial Similarity*

The principle of substantial similarity has no corollary in the developed model. The reason is that this principle has a circularity problem. The legal doctrine indicates that infringement is dependent on whether similarity exists. However, the question the court is addressing is how similar the defendant's product can be before it infringes the plaintiff's copyright (i.e., the breadth of protection).

7. *Type of Software*

Section VI labeled copying as a type of competition. Since the type of software issue is related to the feasibility of copying, it is really related to the existence of competition. As above, the legal doctrine has totally ignored this aspect, as it has ignored the issue from the perspective of the consumer.

In addition, this factor reveals another shortcoming of the legal doctrine. It fails to distinguish traditional copyrightable works (i.e., art and literature) from technological works. For example, the value of a work of art is generally in its viewing, and this type of enjoyment is not specific to the work. In contrast, a computer program may be used for further productive purposes and may be the only program which performs the particular task. Other works, such as artwork, will exhibit a high degree of substitutability (i.e., a high degree of competition), while a computer program may not. Further, hindering the use of software may hinder other (non-innovative) productive activities, while this is generally not the case with art.

As discussed above, a product which is easily substitutable (by either other products or copying), like a video game, has less problem with underutilization. However, a program which is not as substitutable, like a specialized program, has a high problem with underutilization. This is a distinction which is not ordinarily faced with traditional works.

8. *Damages*

Since this section deals with the optimality of a statute, this section is not the primary focus of this paper. However, an improper award of damages has the same effect as underprotection or overprotection. Damages therefore deserve some discussion.

The Copyright Act of 1976 states that the plaintiff can recover his actual damages plus the defendant's profits.[71] However, the defendant's profits are only recoverable if they are not a part of the actual damages.[72]

Commentators seem to be confused on the meaning of this law.[73] While unclear with other works, the meaning is clear with marketable software. Generally, the plaintiff's actual damages will be lost sales (plus consequential damages). Presumably, these sales were lost to the defendant. Since this translates into profits for the defendant, the lost sales of the plaintiff can overlap the profits of the defendant.

What if the defendant's sales are larger than sales lost by the plain-

71. 17 U.S.C. § 504(b) (1990).

72. *Id.*

73. *See* NIMMER ON COPYRIGHT § 14.01 (1963 & Supp. 1990).

tiff? In other words, an issue arises when the defendant made some sales that the plaintiff would never have received.[74] Should these incremental sales be discouraged?[75] The statute discourages this activity even though the use is increased without diminishing the producer's incentive (i.e., the producer loses nothing). Therefore, the question is how can we allow the incremental sales without diminishing the innovator's incentive (e.g., by losing sales to the challenger).

If the court places an injunction on all of the defendant's sales, will the plaintiff ignore the incremental potential sales (assuming that for whatever reason this plaintiff is unable to exploit these sales)? Generally not. The optimal solution is for the plaintiff to grant a license to the defendant for those incremental sales. Therefore, the value of a license may be the appropriate value for damages.[76]

C. CONCLUSIONS ON APPLICATION OF THE MODEL

There is an inherent difficulty in dealing with court cases. This Note has chosen a broad scope. A court's scope is limited to the plaintiff and the defendant. Society is not a party, and therefore it may be unfair to expect judges to adjudicate cases on behalf of society.

Nonetheless, on the whole, legal rules are generally expected to help the court reach a normative end. With some minor adjustments, the legal doctrine does fairly well in maximizing innovation. The one difference is that many of the principles of the legal doctrine are implicit while the principles of the developed model are explicit.

The legal doctrine, however, completely misses the target when maximizing innovation does not maximize social welfare. It completely ignores the principle that the value of an innovation (or any product) is in its use. While this underutilization problem is less significant with traditional works, it can be very significant for technological works.

IX. INTERNATIONAL DIMENSIONS

A major factor which has not been developed in the preceding model is the problem of international competition. The preceding model has implicitly assumed that the United States federal government has sole control over computer copyright. This is a fair assumption for domestic cases but is obviously false for international cases.

The impact of technology ownership on national economies, and

74. See discussion on "True Market" *supra* text accompanying note 51.

75. Punishment (i.e., punitive damages) is only appropriate when deterrence is the goal; when wilful misconduct is evident.

76. This example is limited to where direct negotiation is possible. In this instance, the court is actually deciding which party will have the upper hand in negotiations rather than making a final adjudication.

the resulting welfare effect, has not been discussed. But if we presume that the impact is not zero, it is apparent that this is an area worthy of study.

This international dimension was made more acute when the United States joined the Berne Convention. Under the Berne Convention, in principle, creators have automatic copyright protection for works that have a valid copyright in the home country (after registration) in any Berne Convention member country. Thus, court decisions not only have a national impact, but an international impact as well.

X. CONCLUSION

The United States Supreme Court has stated the normative theory of intellectual property: "The economic philosophy behind the clause empowering Congress to grant patents and copyrights is the conviction that encouragement of individual effort by personal gain is the best way to advance public welfare through the talents of authors and inventors in 'Science and useful Arts.' "[77]

The Supreme Court has therefore acknowledged that economics is the normative basis for intellectual property. Further, the Court has stated that the welfare of the public, as opposed to the welfare of artists and inventors, is the normative goal.

Unfortunately, the common law rules presented by various courts are framed in the rhetoric of traditional theories. Not unexpectedly, the framing of economic normative goals in traditional rhetoric has lead to ambiguous and confusing language.

This Note has presented an economic rational for copyright and has presented it in economic rhetoric. This is an attempt to present an alternative to the concepts now used. The model and theory developed in this Note are less ambiguous and more flexible to meet the needs of a rapidly changing environment.

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77. Mazer v. Stein, 347 U.S. 201, 219 (1954).

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