

The Wealth of Networks: How Social Production Transforms Markets and Freedom by Yochai Benkler, Yale University Press

© Copyright 2006, Yochai Benkler.

Chapter 2 Some Basic Economics of Information Production and Innovation

The Diversity of Strategies in our Current Information Production System

The Effects of Exclusive Rights

When Information Production Meets the Computer Network

Strong Exclusive Rights in the Digital Environment

Epigraph

"Human nature is not a machine to be built after a model, and set to do exactly the work prescribed for it, but a tree, which requires to grow and develop itself on all sides, according to the tendency of the inward forces which make it a living thing."

"Such are the differences among human beings in their sources of pleasure, their susceptibilities of pain, and the operation on them of different physical and moral agencies, that unless there is a corresponding diversity in their modes of life, they neither obtain their fair share of happiness, nor grow up to the mental, moral, and aesthetic stature of which their nature is capable."

John Stuart Mill, On Liberty (1859)

This online version has been created under a **Creative Commons Attribution ShareAlike** license - see www.benkler.org - and has been reformatted and designated as recommended reading - with an accompanying Moodle course - for the **NGO Committee on Education of CONGO** - the **Conference Of Non-Governmental Organizations** in Consultative Relationship with the United Nations - in conjunction with the Committee's commitment to the **United Nations Decade of Education for Sustainable Development**, the **International Decade for a Culture of Peace and Non-violence for the Children of the World** and related international Decades, agreements, conventions and treaties.

Chapter 2

Some Basic Economics of Information Production and Innovation

There are no noncommercial automobile manufacturers. There are no volunteer steel foundries. You would never choose to have your primary source of bread depend on voluntary contributions from others. Nevertheless, scientists working at noncommercial research institutes funded by nonprofit educational institutions and government grants produce most of our basic science. Widespread cooperative networks of volunteers write the software and standards that run most of the Internet and enable what we do with it. Many people turn to National Public Radio or the BBC as a reliable source of news. What is it about information that explains this difference? Why do we rely almost exclusively on markets and commercial firms to produce cars, steel, and wheat, but much less so for the most critical information our advanced societies depend on? Is this a historical contingency, or is there something about information as an object of production that makes nonmarket production attractive?

The technical economic answer is that certain characteristics of information and culture lead us to understand them as "public goods," rather than as "pure private goods" or standard "economic goods." When economists speak of information, they usually say that it is "nonrival." We consider a good to be nonrival when its consumption by one person does not make it any less available for consumption by another. Once such a good is produced, no more social resources need be invested in creating more of it to satisfy the next consumer. Apples are rival. If I eat this apple, you cannot eat it. If you nonetheless want to eat an apple, more resources (trees, labor) need to be diverted from, say, building chairs, to growing apples, to satisfy you. The social cost of your consuming the second apple is the cost of not using the resources needed to grow the second apple (the wood from the tree) in their next best use. In other words, it is the cost to society of not having the additional chairs that could have been made from the tree. Information is nonrival. Once a scientist has established a fact, or once Tolstoy has written *War and Peace*, neither the scientist nor Tolstoy need spend a single second on producing additional *War and Peace* manuscripts or studies for the one-hundredth, one-thousandth, or one-millionth user of what they wrote. The physical paper for the book or journal costs something, but the information itself need only be created once. Economists call such goods "public" because a market will not produce them if priced at their marginal cost - zero. In order to provide Tolstoy or the scientist with income, we regulate publishing: We pass laws that enable their publishers to prevent competitors from entering the market. Because no competitors are permitted into the market for copies of *War and Peace*, the publishers can price the contents of the book or journal at above their actual marginal cost of zero. They can then turn some of that excess revenue over to Tolstoy. Even if these laws are therefore necessary to create the incentives for publication, the market that develops based on them will, from the technical economic perspective, systematically be inefficient. As Kenneth Arrow put it in 1962, "precisely to the extent that [property] is effective, there is underutilization of the information."¹ Because welfare economics defines a market as producing a good efficiently only when it is pricing the good at its marginal cost, a good like information (and culture and knowledge are, for purposes of economics, forms of information), which can never be sold both at a positive (greater than zero) price and at its marginal cost, is fundamentally a candidate for substantial nonmarket production.

This widely held explanation of the economics of information production has led to an understanding that markets based on patents or copyrights involve a trade-off between static and

dynamic efficiency. That is, looking at the state of the world on any given day, it is inefficient that people and firms sell the information they possess. From the perspective of a society's overall welfare, the most efficient thing would be for those who possess information to give it away for free - or rather, for the cost of communicating it and no more. On any given day, enforcing copyright law leads to inefficient underutilization of copyrighted information. However, looking at the problem of information production over time, the standard defense of exclusive rights like copyright expects firms and people not to produce if they know that their products will be available for anyone to take for free. In order to harness the efforts of individuals and firms that want to make money, we are willing to trade off some static inefficiency to achieve dynamic efficiency. That is, we are willing to have some inefficient lack of access to information every day, in exchange for getting more people involved in information production over time. Authors and inventors or, more commonly, companies that contract with musicians and filmmakers, scientists, and engineers, will invest in research and create cultural goods because they expect to sell their information products. Over time, this incentive effect will give us more innovation and creativity, which will outweigh the inefficiency at any given moment caused by selling the information at above its marginal cost. This defense of exclusive rights is limited by the extent to which it correctly describes the motivations of information producers and the business models open to them to appropriate the benefits of their investments. If some information producers do not need to capture the economic benefits of their particular information outputs, or if some businesses can capture the economic value of their information production by means other than exclusive control over their products, then the justification for regulating access by granting copyrights or patents is weakened. As I will discuss in detail, both of these limits on the standard defense are in fact the case.

Nonrivalry, moreover, is not the only quirky characteristic of information production as an economic phenomenon. The other crucial quirkiness is that information is both input and output of its own production process. In order to write today's academic or news article, I need access to yesterday's articles and reports. In order to write today's novel, movie, or song, I need to use and rework existing cultural forms, such as story lines and twists. This characteristic is known to economists as the "on the shoulders of giants" effect, recalling a statement attributed to Isaac Newton: "If I have seen farther it is because I stand on the shoulders of giants."² This second quirkiness of information as a production good makes property-like exclusive rights less appealing as the dominant institutional arrangement for information and cultural production than it would have been had the sole quirky characteristic of information been its nonrivalry. The reason is that if any new information good or innovation builds on existing information, then strengthening intellectual property rights increases the prices that those who invest in producing information today must pay to those who did so yesterday, in addition to increasing the rewards an information producer can get tomorrow. Given the nonrivalry, those payments made today for yesterday's information are all inefficiently too high, from today's perspective. They are all above the marginal cost - zero. Today's users of information are not only today's readers and consumers. They are also today's producers and tomorrow's innovators. Their net benefit from a strengthened patent or copyright regime, given not only increased potential revenues but also the increased costs, may be negative. If we pass a law that regulates information production too strictly, allowing its beneficiaries to impose prices that are too high on today's innovators, then we will have not only too little consumption of information today, but also too little production of new information for tomorrow.

Perhaps the most amazing document of the consensus among economists today that, because of the combination of nonrivalry and the "on the shoulders of giants" effect, excessive expansion of "intellectual property" protection is economically detrimental, was the economists' brief filed in the Supreme Court case of *Eldred v. Ashcroft*.³ The case challenged a law that extended the term of

copyright protection from lasting for the life of the author plus fifty years, to life of the author plus seventy years, or from seventy-five years to ninety-five years for copyrights owned by corporations. If information were like land or iron, the ideal length of property rights would be infinite from the economists' perspective. In this case, however, where the "property right" was copyright, more than two dozen leading economists volunteered to sign a brief opposing the law, counting among their number five Nobel laureates, including that well-known market skeptic, Milton Friedman.

The efficiency of regulating information, knowledge, and cultural production through strong copyright and patent is not only theoretically ambiguous, it also lacks empirical basis. The empirical work trying to assess the impact of intellectual property on innovation has focused to date on patents. The evidence provides little basis to support stronger and increasing exclusive rights of the type we saw in the last two and a half decades of the twentieth century. Practically no studies show a clear-cut benefit to stronger or longer patents.⁴ In perhaps one of the most startling papers on the economics of innovation published in the past few years, Josh Lerner looked at changes in intellectual property law in sixty countries over a period of 150 years. He studied close to three hundred policy changes, and found that, both in developing countries and in economically advanced countries that already have patent law, patenting both at home and abroad by domestic firms of the country that made the policy change, a proxy for their investment in research and development, decreases slightly when patent law is strengthened!⁵ The implication is that when a country - either one that already has a significant patent system, or a developing nation - increases its patent protection, it slightly decreases the level of investment in innovation by local firms. Going on intuitions alone, without understanding the background theory, this seems implausible - why would inventors or companies innovate less when they get more protection? Once you understand the interaction of nonrivalry and the "on the shoulders of giants" effect, the findings are entirely consistent with theory. Increasing patent protection, both in developing nations that are net importers of existing technology and science, and in developed nations that already have a degree of patent protection, and therefore some nontrivial protection for inventors, increases the costs that current innovators have to pay on existing knowledge more than it increases their ability to appropriate the value of their own contributions. When one cuts through the rent-seeking politics of intellectual property lobbies like the pharmaceutical companies or Hollywood and the recording industry; when one overcomes the honestly erroneous, but nonetheless conscience-soothing beliefs of lawyers who defend the copyright and patent-dependent industries and the judges they later become, the reality of both theory and empirics in the economics of intellectual property is that both in theory and as far as empirical evidence shows, there is remarkably little support in economics for regulating information, knowledge, and cultural production through the tools of intellectual property law.

Where does innovation and information production come from, then, if it does not come as much from intellectual-property-based market actors, as many generally believe? The answer is that it comes mostly from a mixture of (1) nonmarket sources - both state and nonstate - and (2) market actors whose business models do not depend on the regulatory framework of intellectual property. The former type of producer is the expected answer, within mainstream economics, for a public goods problem like information production. The National Institutes of Health, the National Science Foundation, and the Defense Department are major sources of funding for research in the United States, as are government agencies in Europe, at the national and European level, Japan, and other major industrialized nations. The latter type - that is, the presence and importance of market-based producers whose business models do not require and do not depend on intellectual property protection - is not theoretically predicted by that model, but is entirely obvious once you begin to think about it.

Consider a daily newspaper. Normally, we think of newspapers as dependent on copyrights. In fact, however, that would be a mistake. No daily newspaper would survive if it depended for its business on waiting until a competitor came out with an edition, then copied the stories, and reproduced them in a competing edition. Daily newspapers earn their revenue from a combination of low-priced newsstand sales or subscriptions together with advertising revenues. Neither of those is copyright dependent once we understand that consumers will not wait half a day until the competitor's paper comes out to save a nickel or a quarter on the price of the newspaper. If all copyright on newspapers were abolished, the revenues of newspapers would be little affected.⁶ Take, for example, the 2003 annual reports of a few of the leading newspaper companies in the United States. The New York Times Company receives a little more than \$3 billion a year from advertising and circulation revenues, and a little more than \$200 million a year in revenues from all other sources. Even if the entire amount of "other sources" were from syndication of stories and photos - which likely overstates the role of these copyright-dependent sources - it would account for little more than 6 percent of total revenues. The net operating revenues for the Gannett Company were more than \$5.6 billion in newspaper advertising and circulation revenue, relative to about \$380 million in all other revenues. As with the *New York Times*, at most a little more than 6 percent of revenues could be attributed to copyright-dependent activities. For Knight Ridder, the 2003 numbers were \$2.8 billion and \$100 million, respectively, or a maximum of about 3.5 percent from copyrights. Given these numbers, it is safe to say that daily newspapers are not a copyright-dependent industry, although they are clearly a market-based information production industry.

As it turns out, repeated survey studies since 1981 have shown that in all industrial sectors except for very few - most notably pharmaceuticals - firm managers do not see patents as the most important way they capture the benefits of their research and developments.⁷ They rank the advantages that strong research and development gives them in lowering the cost or improving the quality of manufacture, being the first in the market, or developing strong marketing relationships as more important than patents. The term "intellectual property" has high cultural visibility today. Hollywood, the recording industry, and pharmaceuticals occupy center stage on the national and international policy agenda for information policy. However, in the overall mix of our information, knowledge, and cultural production system, the total weight of these exclusivity-based market actors is surprisingly small relative to the combination of nonmarket sectors, government and nonprofit, and market-based actors whose business models do not depend on proprietary exclusion from their information outputs.

The upshot of the mainstream economic analysis of information production today is that the widely held intuition that markets are more or less the best way to produce goods, that property rights and contracts are efficient ways of organizing production decisions, and that subsidies distort production decisions, is only very ambiguously applicable to information. While exclusive rights-based production can partially solve the problem of how information will be produced in our society, a comprehensive regulatory system that tries to mimic property in this area - such as both the United States and the European Union have tried to implement internally and through international agreements - simply cannot work perfectly, even in an ideal market posited by the most abstract economics models. Instead, we find the majority of businesses in most sectors reporting that they do not rely on intellectual property as a primary mechanism for appropriating the benefits of their research and development investments. In addition, we find mainstream economists believing that there is a substantial role for government funding; that nonprofit research can be more efficient than for-profit research; and, otherwise, that nonproprietary production can play an important role in our information production system.

The Diversity of Strategies in our Current Information Production System

The actual universe of information production in the economy then, is not as dependent on property rights and markets in information goods as the last quarter century's increasing obsession with "intellectual property" might suggest. Instead, what we see both from empirical work and theoretical work is that individuals and firms in the economy produce information using a wide range of strategies. Some of these strategies indeed rely on exclusive rights like patents or copyrights, and aim at selling information as a good into an information market. Many, however, do not. In order to provide some texture to what these models look like, we can outline a series of ideal-type "business" strategies for producing information. The point here is not to provide an exhaustive map of the empirical business literature. It is, instead, to offer a simple analytic framework within which to understand the mix of strategies available for firms and individuals to appropriate the benefits of their investments - of time, money, or both, in activities that result in the production of information, knowledge, and culture. The differentiating parameters are simple: cost minimization and benefit maximization. Any of these strategies could use inputs that are already owned - such as existing lyrics for a song or a patented invention to improve on - by buying a license from the owner of the exclusive rights for the existing information. Cost minimization here refers purely to ideal-type strategies for obtaining as many of the information inputs as possible at their marginal cost of zero, instead of buying licenses to inputs at a positive market price. It can be pursued by using materials from the public domain, by using materials the producer itself owns, or by sharing/bartering for information inputs owned by others in exchange for one's own information inputs. Benefits can be obtained either in reliance on asserting one's exclusive rights, or by following a non-exclusive strategy, using some other mechanism that improves the position of the information producer because they invested in producing the information. Nonexclusive strategies for benefit maximization can be pursued both by market actors and by nonmarket actors. Table 2.1 maps nine ideal-type strategies characterized by these components.

The ideal-type strategy that underlies patents and copyrights can be thought of as the "Romantic Maximizer." It conceives of the information producer as a single author or inventor laboring creatively - hence romantic - but in expectation of royalties, rather than immortality, beauty, or truth. An individual or small start-up firm that sells software it developed to a larger firm, or an author selling rights to a book or a film typify this model. The second ideal type that arises within exclusive-rights based industries, "Mickey," is a larger firm that already owns an inventory of exclusive rights, some through in-house development, some by buying from Romantic Maximizers. A defining cost-reduction mechanism for Mickey is that it applies creative people to work on its own inventory, for which it need not pay above marginal cost prices in the market. This strategy is the most advantageous in an environment of very strong exclusive rights protection for a number of reasons. First, the ability to extract higher rents from the existing inventory of information goods is greatest for firms that (a) have an inventory and (b) rely on asserting exclusive rights as their mode of extracting value. Second, the increased costs of production associated with strong exclusive rights are cushioned by the ability of such firms to rework their existing inventory, rather than trying to work with materials from an ever-shrinking public domain or paying for every source of inspiration and element of a new composition. The coarsest version of this strategy might be found if Disney were to produce a "winter sports" thirty-minute television program by tying together scenes from existing cartoons, say, one in which Goofy plays hockey followed by a snippet of Donald Duck ice skating, and so on. More subtle, and representative of the type of reuse relevant to the analysis here, would be the case where Disney buys the rights to Winnie-the-Pooh, and, after producing an animated version of stories from the original books, then continues to work with the same characters and relationships to create a new film, say, *Winnie-the-Pooh-Frankenpooh* (or *Beauty and the Beast-Enchanted Christmas*; or *The Little Mermaid-Stormy the Wild Seaborse*).

Table 2.1: Ideal-Type Information Production Strategies

Cost Minimization/ Benefit Acquisition	Public Domain	Intrafirm	Barter/Sharing
<i>Rights-based exclusion</i> (make money by exercising exclusive rights - licensing or blocking competition)	<i>Romantic Maximizers</i> (authors, composers; sell to publishers; sometimes sell to Miceys)	<i>Mickey</i> (Disney reuses inventory for derivative works; buy outputs of Romantic Maximizers)	<i>RCA</i> (small number of companies hold blocking patents; they create patent pools to build valuable goods)
<i>Nonexclusion-Market</i> (make money from information production but not by exercising the exclusive rights)	<i>Scholarly Lawyers</i> (write articles to get clients; other examples include bands that give music out for free as advertisements for touring and charge money for performance; software developers who develop software and make money from customizing it to a particular client, on-site management, advice and training, not from licensing)	<i>Know-How</i> (firms that have cheaper or better production processes because of their research, lower their costs or improve the quality of other goods or services; lawyer offices that build on existing forms)	<i>Learning Networks</i> (share information with similar organizations - make money from early access to information. For example, newspapers join together to create a wire service; firms where engineers and scientists from different firms attend professional societies to diffuse knowledge)
<i>Nonexclusion-Nonmarket</i>	<i>Joe Einstein</i> (give away information for free in return for status, benefits to reputation, value of the innovation to themselves; wide range of motivations. Includes members of amateur choirs who perform for free, academics who write articles for fame, people who write op-eds, contribute to mailing lists; many free software developers and free software generally for most uses)	<i>Los Alamos</i> (share in-house information, rely on in-house inputs to produce valuable public goods used to secure additional government funding and status)	<i>Limited sharing networks</i> (release paper to small number of colleagues to get comments so you can improve it before publication. Make use of time delay to gain relative advantage later on using Joe Einstein strategy. Share one's information on formal condition of reciprocity: like "copyleft" conditions on derivative works for distribution)

The third exclusive-rights-based strategy, which I call "RCA," is barter among the owners of inventories. Patent pools, cross-licensing, and market-sharing agreements among the radio patents holders in 1920-1921, which I describe in chapter 6, are a perfect example. RCA, GE, AT&T, and Westinghouse held blocking patents that prevented each other and anyone else from manufacturing the best radios possible given technology at that time. The four companies entered an agreement to combine their patents and divide the radio equipment and services markets, which they used throughout the 1920s to exclude competitors and to capture precisely the postinnovation monopoly rents sought to be created by patents.

Exclusive-rights-based business models, however, represent only a fraction of our information production system. There are both market-based and nonmarket models to sustain and organize information production. Together, these account for a substantial portion of our information output. Indeed, industry surveys concerned with patents have shown that the vast majority of industrial R&D is pursued with strategies that do not rely primarily on patents. This does not mean that most or any of the firms that pursue these strategies possess or seek no exclusive rights in their information products. It simply means that their production strategy does not depend on asserting these rights through exclusion. One such cluster of strategies, which I call "Scholarly Lawyers," relies on demand-side effects of access to the information the producer distributes. It relies on the fact that sometimes using an information good that one has produced makes its users seek out a relationship with the author. The author then charges for the relationship, not for the information. Doctors or lawyers who publish in trade journals, become known, and get business as a result are an instance of this strategy. An enormously creative industry, much of which operates on this model, is software. About two-thirds of industry revenues in software development come from activities that the Economic Census describes as: (1) writing, modifying, testing, and supporting software to meet the needs of a particular customer; (2) planning and designing computer systems that integrate computer hardware, software, and communication technologies; (3) on-site management and operation of clients' computer systems and/or data processing facilities; and (4) other professional and technical computer-related advice and services, systems consultants, and computer training. "Software publishing," by contrast, the business model that relies on sales based on copyright, accounts for a little more than one-third of the industry's revenues.⁸ Interestingly, this is the model of appropriation that more than a decade ago, Esther Dyson and John Perry Barlow heralded as the future of music and musicians. They argued in the early 1990s for more or less free access to copies of recordings distributed online, which would lead to greater attendance at live gigs. Revenue from performances, rather than recording, would pay artists.

The most common models of industrial R&D outside of pharmaceuticals, however, depend on supply-side effects of information production. One central reason to pursue research is its effects on firm-specific advantages, like production know-how, which permit the firm to produce more efficiently than competitors and sell better or cheaper competing products. Daily newspapers collectively fund news agencies, and individually fund reporters, because their ability to find information and report it is a necessary input into their product - timely news. As I have already suggested, they do not need copyright to protect their revenues. Those are protected by the short half-life of dailies. The investments come in order to be able to play in the market for daily newspapers. Similarly, the learning curve and know-how effects in semiconductors are such that early entry into the market for a new chip will give the first mover significant advantages over competitors. Investment is then made to capture that position, and the investment is captured by the quasi-rents available from the first-mover advantage. In some cases, innovation is necessary in order to be able to produce at the state of the art. Firms participate in "Learning Networks" to gain the benefits of being at the state of the art, and sharing their respective improvements. However, they can only participate if they innovate. If they do not innovate, they lack the in-house capacity to

understand the state of the art and play at it. Their investments are then recouped not from asserting their exclusive rights, but from the fact that they sell into one of a set of markets, access into which is protected by the relatively small number of firms with such absorption capacity, or the ability to function at the edge of the state of the art. Firms of this sort might barter their information for access, or simply be part of a small group of organizations with enough knowledge to exploit the information generated and informally shared by all participants in these learning networks. They obtain rents from the concentrated market structure, not from assertion of property rights.⁹

An excellent example of a business strategy based on nonexclusivity is IBM's. The firm has obtained the largest number of patents every year from 1993 to 2004, amassing in total more than 29,000 patents. IBM has also, however, been one of the firms most aggressively engaged in adapting its business model to the emergence of free software.

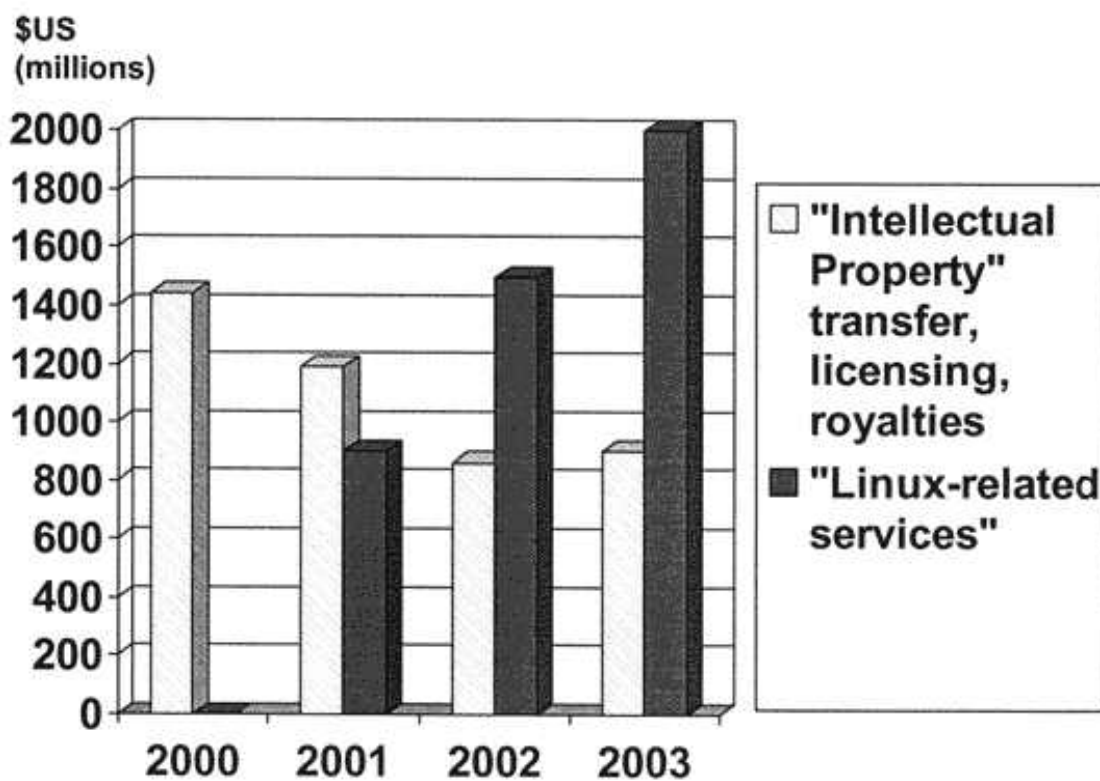


Figure 2.1: Selected IBM Revenues, 2000-2003

Figure 2.1 shows what happened to the relative weight of patent royalties, licenses, and sales in IBM's revenues and revenues that the firm described as coming from "Linux-related services." Within a span of four years, the Linux-related services category moved from accounting for practically no revenues, to providing double the revenues from all patent-related sources, of the firm that has been the most patent-productive in the United States. IBM has described itself as investing more than a billion dollars in free software developers, hired programmers to help develop the Linux kernel and other free software; and donated patents to the Free Software Foundation. What this does for the firm is provide it with a better operating system for its server business - making the servers better, faster, more reliable, and therefore more valuable to consumers. Participating in free software development has also allowed IBM to develop service relationships with its customers, building on free software to offer customer-specific solutions. In other words, IBM has combined both supply-side and demand-side strategies to adopt a nonproprietary business model that has generated more than \$2 billion yearly of business for the firm. Its strategy is, if not symbiotic, certainly complementary to free software.

I began this chapter with a puzzle - advanced economies rely on nonmarket organizations for information production much more than they do in other sectors. The puzzle reflects the fact that alongside the diversity of market-oriented business models for information production there is a wide diversity of nonmarket models as well. At a broad level of abstraction, I designate this diversity of motivations and organizational forms as "Joe Einstein" - to underscore the breadth of the range of social practices and practitioners of nonmarket production. These include universities and other research institutes; government research labs that publicize their work, or government information agencies like the Census Bureau. They also include individuals, like academics; authors and artists who play to "immortality" rather than seek to maximize the revenue from their creation. Eric von Hippel has for many years documented user innovation in areas ranging from surfboard design to new mechanisms for pushing electric wiring through insulation tiles.¹⁰ The Oratorio Society of New York, whose chorus members are all volunteers, has filled Carnegie Hall every December with a performance of Handel's *Messiah* since the theatre's first season in 1891. Political parties, advocacy groups, and churches are but few of the stable social organizations that fill our information environment with news and views. For symmetry purposes in table 2.1, we also see reliance on internal inventories by some nonmarket organizations, like secret government labs that do not release their information outputs, but use it to continue to obtain public funding. This is what I call "Los Alamos." Sharing in limited networks also occurs in nonmarket relationships, as when academic colleagues circulate a draft to get comments. In the nonmarket, nonproprietary domain, however, these strategies were in the past relatively smaller in scope and significance than the simple act of taking from the public domain and contributing back to it that typifies most Joe Einstein behaviors. Only since the mid-1980s have we begun to see a shift from releasing into the public domain to adoption of commons-binding licensing, like the "copyleft" strategies I describe in chapter 3. What makes these strategies distinct from Joe Einstein is that they formalize the requirement of reciprocity, at least for some set of rights shared.

My point is not to provide an exhaustive list of all the ways we produce information. It is simply to offer some texture to the statement that information, knowledge, and culture are produced in diverse ways in contemporary society. Doing so allows us to understand the comparatively limited role that production based purely on exclusive rights-like patents, copyrights, and similar regulatory constraints on the use and exchange of information - has played in our information production system to this day. It is not new or mysterious to suggest that nonmarket production is important to information production. It is not new or mysterious to suggest that efficiency increases whenever it is possible to produce information in a way that allows the producer - whether market actor or not - to appropriate the benefits of production without actually charging a price for use of the

information itself. Such strategies are legion among both market and nonmarket actors. Recognizing this raises two distinct questions: First, how does the cluster of mechanisms that make up intellectual property law affect this mix? Second, how do we account for the mix of strategies at any given time? Why, for example, did proprietary, market-based production become so salient in music and movies in the twentieth century, and what is it about the digitally networked environment that could change this mix?

The Effects of Exclusive Rights

Once we recognize that there are diverse strategies of appropriation for information production, we come to see a new source of inefficiency caused by strong "intellectual property"-type rights. Recall that in the mainstream analysis, exclusive rights always cause static inefficiency - that is, they allow producers to charge positive prices for products (information) that have a zero marginal cost. Exclusive rights have a more ambiguous effect dynamically. They raise the expected returns from information production, and thereby are thought to induce investment in information production and innovation. However, they also increase the costs of information inputs. If existing innovations are more likely covered by patent, then current producers will more likely have to pay for innovations or uses that in the past would have been available freely from the public domain. Whether, overall, any given regulatory change that increases the scope of exclusive rights improves or undermines new innovation therefore depends on whether, given the level of appropriability that preceded it, it increased input costs more or less than it increased the prospect of being paid for one's outputs.

The diversity of appropriation strategies adds one more kink to this story. Consider the following very simple hypothetical. Imagine an industry that produces "infowidgets." There are ten firms in the business. Two of them are infowidget publishers on the Romantic Maximizer model. They produce infowidgets as finished goods, and sell them based on patent. Six firms produce infowidgets on supply-side (Know-How) or demand-side (Scholarly Lawyer) effects: they make their Realwidgets or Servicewidgets more efficient or desirable to consumers, respectively. Two firms are nonprofit infowidget producers that exist on a fixed, philanthropically endowed income. Each firm produces five infowidgets, for a total market supply of fifty. Now imagine a change in law that increases exclusivity. Assume that this is a change in law that, absent diversity of appropriation, would be considered efficient. Say it increases input costs by 10 percent and appropriability by 20 percent, for a net expected gain of 10 percent. The two infowidget publishers would each see a 10 percent net gain, and let us assume that this would cause each to increase its efforts by 10 percent and produce 10 percent more infowidgets. Looking at these two firms alone, the change in law caused an increase from ten infowidgets to eleven - a gain for the policy change. Looking at the market as a whole, however, eight firms see an increase of 10 percent in costs, and no gain in appropriability. This is because none of these firms actually relies on exclusive rights to appropriate its product's value. If, commensurate with our assumption for the publishers, we assume that this results in a decline in effort and productivity of 10 percent for the eight firms, we would see these firms decline from forty infowidgets to thirty-six, and total market production would decline from fifty infowidgets to forty-seven.

Another kind of effect for the change in law may be to persuade some of the firms to shift strategies or to consolidate. Imagine, for example, that most of the inputs required by the two publishers were owned by the other infowidget publisher. If the two firms merged into one Mickey, each could use the outputs of the other at its marginal cost - zero - instead of at its exclusive-rights market price. The increase in exclusive rights would then not affect the merged firm's costs, only the costs of outside firms that would have to buy the merged firm's outputs from the market.

Given this dynamic, strong exclusive rights drive concentration of inventory owners. We see this very clearly in the increasing sizes of inventory-based firms like Disney. Moreover, the increased appropriability in the exclusive-rights market will likely shift some firms at the margin of the nonproprietary business models to adopt proprietary business models. This, in turn, will increase the amount of information available only from proprietary sources. The feedback effect will further accelerate the rise in information input costs, increasing the gains from shifting to a proprietary strategy and to consolidating larger inventories with new production.

Given diverse strategies, the primary unambiguous effect of increasing the scope and force of exclusive rights is to shape the population of business strategies. Strong exclusive rights increase the attractiveness of exclusive-rights-based strategies at the expense of nonproprietary strategies, whether market-based or nonmarket based. They also increase the value and attraction of consolidation of large inventories of existing information with new production.

When Information Production Meets the Computer Network

Music in the nineteenth century was largely a relational good. It was something people did in the physical presence of each other: in the folk way through hearing, repeating, and improvising; in the middle-class way of buying sheet music and playing for guests or attending public performances; or in the upper-class way of hiring musicians. Capital was widely distributed among musicians in the form of instruments, or geographically dispersed in the hands of performance hall (and drawing room) owners. Market-based production depended on performance through presence. It provided opportunities for artists to live and perform locally, or to reach stardom in cultural centers, but without displacing the local performers. With the introduction of the phonograph, a new, more passive relationship to played music was made possible in reliance on the high-capital requirements of recording, copying, and distributing specific instantiations of recorded music - records. What developed was a concentrated, commercial industry, based on massive financial investments in advertising, or preference formation, aimed at getting ever-larger crowds to want those recordings that the recording executives had chosen. In other words, the music industry took on a more industrial model of production, and many of the local venues - from the living room to the local dance hall - came to be occupied by mechanical recordings rather than amateur and professional local performances. This model crowded out some, but not all, of the live-performance-based markets (for example, jazz clubs, piano bars, or weddings), and created new live-performance markets - the megastar concert tour. The music industry shifted from a reliance on Scholarly Lawyer and Joe Einstein models to reliance on Romantic Maximizer and Mickey models. As computers became more music-capable and digital networks became a ubiquitously available distribution medium, we saw the emergence of the present conflict over the regulation of cultural production - the law of copyright - between the twentieth-century, industrial model recording industry and the emerging amateur distribution systems coupled, at least according to its supporters, to a reemergence of decentralized, relation-based markets for professional performance artists.

This stylized story of the music industry typifies the mass media more generally. Since the introduction of the mechanical press and the telegraph, followed by the phonograph, film, the high-powered radio transmitter, and through to the cable plant or satellite, the capital costs of fixing information and cultural goods in a transmission medium - a high-circulation newspaper, a record or movie, a radio or television program - have been high and increasing. The high physical and financial capital costs involved in making a widely accessible information good and distributing it to the increasingly larger communities (brought together by better transportation systems and more interlinked economic and political systems) muted the relative role of nonmarket production, and emphasized the role of those firms that could muster the financial and physical capital necessary to

communicate on a mass scale. Just as these large, industrial-age machine requirements increased the capital costs involved in information and cultural production, thereby triggering commercialization and concentration of much of this sector, so too ubiquitously available cheap processors have dramatically reduced the capital input costs required to fix information and cultural expressions and communicate them globally. By doing so, they have rendered feasible a radical reorganization of our information and cultural production system, away from heavy reliance on commercial, concentrated business models and toward greater reliance on nonproprietary appropriation strategies, in particular nonmarket strategies whose efficacy was dampened throughout the industrial period by the high capital costs of effective communication.

Information and cultural production have three primary categories of inputs. The first is existing information and culture. We already know that existing information is a nonrival good - that is, its real marginal cost at any given moment is zero. The second major cost is that of the mechanical means of sensing our environment, processing it, and communicating new information goods. This is the high cost that typified the industrial model, and which has drastically declined in computer networks. The third factor is human communicative capacity - the creativity, experience, and cultural awareness necessary to take from the universe of existing information and cultural resources and turn them into new insights, symbols, or representations meaningful to others with whom we converse. Given the zero cost of existing information and the declining cost of communication and processing, human capacity becomes the primary scarce resource in the networked information economy.

Human communicative capacity, however, is an input with radically different characteristics than those of, say, printing presses or satellites. It is held by each individual, and cannot be "transferred" from one person to another or aggregated like so many machines. It is something each of us innately has, though in divergent quanta and qualities. Individual human capacities, rather than the capacity to aggregate financial capital, become the economic core of our information and cultural production. Some of that human capacity is currently, and will continue to be, traded through markets in creative labor. However, its liberation from the constraints of physical capital leaves creative human beings much freer to engage in a wide range of information and cultural production practices than those they could afford to participate in when, in addition to creativity, experience, cultural awareness and time, one needed a few million dollars to engage in information production. From our friendships to our communities we live life and exchange ideas, insights, and expressions in many more diverse relations than those mediated by the market. In the physical economy, these relationships were largely relegated to spaces outside of our economic production system. The promise of the networked information economy is to bring this rich diversity of social life smack into the middle of our economy and our productive lives.

Let's do a little experiment. Imagine that you were performing a Web search with me. Imagine that we were using Google as our search engine, and that what we wanted to do was answer the questions of an inquisitive six-year-old about Viking ships. What would we get, sitting in front of our computers and plugging in a search request for "Viking Ships"? The first site is Canadian, and includes a collection of resources, essays, and worksheets. An enterprising elementary school teacher at the Gander Academy in Newfoundland seems to have put these together. He has essays on different questions, and links to sites hosted by a wide range of individuals and organizations, such as a Swedish museum, individual sites hosted on geocities, and even to a specific picture of a replica Viking ship, hosted on a commercial site dedicated to selling nautical replicas. In other words, it is a Joe Einstein site that points to other sites, which in turn use either Joe Einstein or Scholarly Lawyer strategies. This multiplicity of sources of information that show up on the very first site is then replicated as one continues to explore the remaining links. The second link is to a

Norwegian site called "the Viking Network," a Web ring dedicated to preparing and hosting short essays on Vikings. It includes brief essays, maps, and external links, such as one to an article in *Scientific American*. "To become a member you must produce an Information Sheet on the Vikings in your local area and send it in electronic format to Viking Network. Your info-sheet will then be included in the Viking Network web." The third site is maintained by a Danish commercial photographer, and hosted in Copenhagen, in a portion dedicated to photographs of archeological finds and replicas of Danish Viking ships. A retired professor from the University of Pittsburgh runs the fourth. The fifth is somewhere between a hobby and a showcase for the services of an individual, independent Web publisher offering publishing-related services. The sixth and seventh are museums, in Norway and Virginia, respectively. The eighth is the Web site of a hobbyists' group dedicated to building Viking Ship replicas. The ninth includes classroom materials and teaching guides made freely available on the Internet by PBS, the American Public Broadcasting Service. Certainly, if you perform this search now, as you read this book, the rankings will change from those I saw when I ran it; but I venture that the mix, the range and diversity of producers, and the relative salience of nonmarket producers will not change significantly.

The difference that the digitally networked environment makes is its capacity to increase the efficacy, and therefore the importance, of many more, and more diverse, nonmarket producers falling within the general category of Joe Einstein. It makes nonmarket strategies - from individual hobbyists to formal, well-funded nonprofits - vastly more effective than they could be in the mass-media environment. The economics of this phenomenon are neither mysterious nor complex. Imagine the grade-school teacher who wishes to put together ten to twenty pages of materials on Viking ships for schoolchildren. Pre-Internet, he would need to go to one or more libraries and museums, find books with pictures, maps, and text, or take his own photographs (assuming he was permitted by the museums) and write his own texts, combining this research. He would then need to select portions, clear the copyrights to reprint them, find a printing house that would set his text and pictures in a press, pay to print a number of copies, and then distribute them to all children who wanted them. Clearly, research today is simpler and cheaper. Cutting and pasting pictures and texts that are digital is cheaper. Depending on where the teacher is located, it is possible that these initial steps would have been insurmountable, particularly for a teacher in a poorly endowed community without easy access to books on the subject, where research would have required substantial travel. Even once these barriers were surmounted, in the precomputer, pre-Internet days, turning out materials that looked and felt like a high quality product, with high-resolution pictures and maps, and legible print required access to capital-intensive facilities. The cost of creating even one copy of such a product would likely dissuade the teacher from producing the booklet. At most, he might have produced a mimeographed bibliography, and perhaps some text reproduced on a photocopier. Now, place the teacher with a computer and a high-speed Internet connection, at home or in the school library. The cost of production and distribution of the products of his effort are trivial. A Web site can be maintained for a few dollars a month. The computer itself is widely accessible throughout the developed world. It becomes trivial for a teacher to produce the "booklet" - with more information, available to anyone in the world, anywhere, at any time, as long as he is willing to spend some of his free time putting together the booklet rather than watching television or reading a book.

When you multiply these very simple stylized facts by the roughly billion people who live in societies sufficiently wealthy to allow cheap ubiquitous Internet access, the breadth and depth of the transformation we are undergoing begins to become clear. A billion people in advanced economies may have between two billion and six billion spare hours among them, every day. In order to harness these billions of hours, it would take the whole workforce of almost 340,000 workers employed by the entire motion picture and recording industries in the United States put together,

assuming each worker worked forty-hour weeks without taking a single vacation, for between three and eight and a half years! Beyond the sheer potential quantitative capacity, however one wishes to discount it to account for different levels of talent, knowledge, and motivation, a billion volunteers have qualities that make them more likely to produce what others want to read, see, listen to, or experience. They have diverse interests - as diverse as human culture itself. Some care about Viking ships, others about the integrity of voting machines. Some care about obscure music bands, others share a passion for baking. As Eben Moglen put it, "if you wrap the Internet around every person on the planet and spin the planet, software flows in the network. It's an emergent property of connected human minds that they create things for one another's pleasure and to conquer their uneasy sense of being too alone."¹¹ It is this combination of a will to create and to communicate with others, and a shared cultural experience that makes it likely that each of us wants to talk about something that we believe others will also want to talk about, that makes the billion potential participants in today's online conversation, and the six billion in tomorrow's conversation, affirmatively better than the commercial industrial model. When the economics of industrial production require high up-front costs and low marginal costs, the producers must focus on creating a few superstars and making sure that everyone tunes in to listen or watch them. This requires that they focus on averaging out what consumers are most likely to buy. This works reasonably well as long as there is no better substitute. As long as it is expensive to produce music or the evening news, there are indeed few competitors for top billing, and the star system can function. Once every person on the planet, or even only every person living in a wealthy economy and 10-20 percent of those living in poorer countries, can easily talk to their friends and compatriots, the competition becomes tougher. It does not mean that there is no continued role for the mass-produced and mass-marketed cultural products - be they Britney Spears or the broadcast news. It does, however, mean that many more "niche markets" - if markets, rather than conversations, are what they should be called - begin to play an ever-increasing role in the total mix of our cultural production system. The economics of production in a digital environment should lead us to expect an increase in the relative salience of nonmarket production models in the overall mix of our information production system, and it is efficient for this to happen - more information will be produced, and much of it will be available for its users at its marginal cost.

The known quirky characteristics of information and knowledge as production goods have always given nonmarket production a much greater role in this production system than was common in capitalist economies for tangible goods. The dramatic decline in the cost of the material means of producing and exchanging information, knowledge, and culture has substantially decreased the costs of information expression and exchange, and thereby increased the relative efficacy of nonmarket production. When these facts are layered over the fact that information, knowledge, and culture have become the central high-value-added economic activities of the most advanced economies, we find ourselves in a new and unfamiliar social and economic condition. Social behavior that traditionally was relegated to the peripheries of the economy has become central to the most advanced economies. Nonmarket behavior is becoming central to producing our information and cultural environment. Sources of knowledge and cultural edification, through which we come to know and comprehend the world, to form our opinions about it, and to express ourselves in communication with others about what we see and believe have shifted from heavy reliance on commercial, concentrated media, to being produced on a much more widely distributed model, by many actors who are not driven by the imperatives of advertising or the sale of entertainment goods.

Strong Exclusive Rights in the Digital Environment

We now have the basic elements of a clash between incumbent institutions and emerging social practice. Technologies of information and cultural production initially led to the increasing salience of commercial, industrial-model production in these areas. Over the course of the twentieth century, in some of the most culturally visible industries like movies and music, copyright law coevolved with the industrial model. By the end of the twentieth century, copyright was longer, broader, and vastly more encompassing than it had been at the beginning of that century. Other exclusive rights in information, culture, and the fruits of innovation expanded following a similar logic. Strong, broad, exclusive rights like these have predictable effects. They preferentially improve the returns to business models that rely on exclusive rights, like copyrights and patents, at the expense of information and cultural production outside the market or in market relationships that do not depend on exclusive appropriation. They make it more lucrative to consolidate inventories of existing materials. The businesses that developed around the material capital required for production fed back into the political system, which responded by serially optimizing the institutional ecology to fit the needs of the industrial information economy firms at the expense of other information producers.

The networked information economy has upset the apple cart on the technical, material cost side of information production and exchange. The institutional ecology, the political framework (the lobbyists, the habits of legislatures), and the legal culture (the beliefs of judges, the practices of lawyers) have not changed. They are as they developed over the course of the twentieth century - centered on optimizing the conditions of those commercial firms that thrive in the presence of strong exclusive rights in information and culture. The outcome of the conflict between the industrial information economy and its emerging networked alternative will determine whether we evolve into a permission culture, as Lessig warns and projects, or into a society marked by social practice of nonmarket production and cooperative sharing of information, knowledge, and culture of the type I describe throughout this book, and which I argue will improve freedom and justice in liberal societies. Chapter 11 chronicles many of the arenas in which this basic conflict is played out. However, for the remainder of this part and part II, the basic economic understanding I offer here is all that is necessary.

There are diverse motivations and strategies for organizing information production. Their relative attractiveness is to some extent dependent on technology, to some extent on institutional arrangements. The rise that we see today in the efficacy and scope of nonmarket production, and of the peer production that I describe and analyze in the following two chapters, are well within the predictable, given our understanding of the economics of information production. The social practices of information production that form the basis of much of the normative analysis I offer in part II are internally sustainable given the material conditions of information production and exchange in the digitally networked environment. These patterns are unfamiliar to us. They grate on our intuitions about how production happens. They grate on the institutional arrangements we developed over the course of the twentieth century to regulate information and cultural production. But that is because they arise from a quite basically different set of material conditions. We must understand these new modes of production. We must learn to evaluate them and compare their advantages and disadvantages to those of the industrial information producers. And then we must adjust our institutional environment to make way for the new social practices made possible by the networked environment.

Notes

1. The full statement was: "[A]ny information obtained, say a new method of production, should, from the welfare point of view, be available free of charge (apart from the costs of transmitting information). This insures optimal utilization of the information but of course provides no incentive for investment in research. In a free enterprise economy, inventive activity is supported by using the invention to create property rights; precisely to the extent that it is successful, there is an underutilization of information." Kenneth Arrow, "Economic Welfare and the Allocation of Resources for Invention," in *Rate and Direction of Inventive Activity: Economic and Social Factors*, ed. Richard R. Nelson (Princeton, NJ: Princeton University Press, 1962), 616-617.
2. Suzanne Scotchmer, "Standing on the Shoulders of Giants: Cumulative Research and the Patent Law," *Journal of Economic Perspectives* 5 (1991): 29-41.
3. *Eldred v. Ashcroft*, 537 U.S. 186 (2003).
4. Adam Jaffe, "The U.S. Patent System in Transition: Policy Innovation and the Innovation Process," *Research Policy* 29 (2000): 531.
5. Josh Lerner, "Patent Protection and Innovation Over 150 Years" (working paper no. 8977, National Bureau of Economic Research, Cambridge, MA, 2002).
6. At most, a "hot news" exception on the model of *International News Service v. Associated Press*, 248 U.S. 215 (1918), might be required. Even that, however, would only be applicable to online editions that are for pay. In paper, habits of reading, accreditation of the original paper, and first-to-market advantages of even a few hours would be enough. Online, where the first-to-market advantage could shrink to seconds, "hot news" protection may be worthwhile. However, almost all papers are available for free and rely solely on advertising. The benefits of reading a copied version are, at that point, practically insignificant to the reader.
7. Wesley Cohen, R. Nelson, and J. Walsh, "Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)" (working paper no. 7552, National Bureau Economic Research, Cambridge, MA, 2000); Richard Levin et al., "Appropriating the Returns from Industrial Research and Development" *Brookings Papers on Economic Activity* 3 (1987): 783; Mansfield et al., "Imitation Costs and Patents: An Empirical Study," *The Economic Journal* 91 (1981): 907.
8. In the 2002 Economic Census, compare NAICS categories 5415 (computer systems and related services) to NAICS 5112 (software publishing). Between the 1997 Economic Census and the 2002 census, this ratio remained stable, at about 36 percent in 1997 and 37 percent in 2002. See 2002 Economic Census, "Industry Series, Information, Software Publishers, and Computer Systems, Design and Related Services" (Washington, DC: U.S. Census Bureau, 2004).
9. Levin et al., "Appropriating the Returns," 794-796 (secrecy, lead time, and learning-curve advantages regarded as more effective than patents by most firms). See also F. M. Scherer, "Learning by Doing and International Trade in Semiconductors" (faculty research working paper series R94-13, John F. Kennedy School of Government, Harvard University, Cambridge, MA, 1994), an empirical study of semiconductor industry suggesting that for industries with steep learning curves, investment in information production is driven by advantages of being first down

the learning curve rather than the expectation of legal rights of exclusion. The absorption effect is described in Wesley M. Cohen and Daniel A. Leventhal, "Innovation and Learning: The Two Faces of R&D," *The Economic Journal* 99 (1989): 569-596. The collaboration effect was initially described in Richard R. Nelson, "The Simple Economics of Basic Scientific Research," *Journal of Political Economy* 67 (June 1959): 297-306. The most extensive work over the past fifteen years, and the source of the term of learning networks, has been from Woody Powell on knowledge and learning networks. Identifying the role of markets made concentrated by the limited ability to use information, rather than through exclusive rights, was made in F. M. Scherer, "Nordhaus's Theory of Optimal Patent Life: A Geometric Reinterpretation," *American Economic Review* 62 (1972): 422-427.

10. Eric von Hippel, *Democratizing Innovation* (Cambridge, MA: MIT Press, 2005).

11. Eben Moglen, "Anarchism Triumphant: Free Software and the Death of Copyright," *First Monday* (1999), http://www.firstmonday.dk/issues/issue4_8/moglen/