You Can Patent That?

Are Patents on Computer Programs and Business Methods Good for the New Economy?

BY ROBERT M. HUNT

The United States is in the midst of an economic boom sustained in part by rapid technological innovation. Firms are always looking for ways to enhance or protect their market position.

Increasingly, they are turning to patents to protect not just physical inventions, but more abstract ones such as computer programs and even ways of doing business. Two decades ago, many of these patents would have been impossible to obtain, let alone enforce. But almost every day now, another example of these patents is described in the press.

Are these patents really a new phenomenon? Are they good for the economy? This article describes how changes in patent law made it possible for inventors to obtain patents on discoveries as abstract as lines of computer code or simply a way of conducting business. It also examines the potential economic benefits and costs of these new patents.

While it is too soon to quantify these effects, there are good reasons for concern and a number of things we can do to address those concerns. At a minimum, we must reserve patents for inventions that represent more than an obvious combination of existing technologies. We should be willing to increase the resources and expertise available to the patent office to ensure it knows what has already been invented. And when patent disputes reach the courts, decisions of the patent office should carry no more weight than is warranted by the quality of its examinations. Over time, we may find that more radical measures are required. Or we may find that the patent system will adapt to this latest in a series of technological revolutions.

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ENGINES OF GROWTH

In our economy, rising labor productivity is a prerequisite for sustainable economic growth and rising incomes. Between 1996 and 1999, labor productivity grew at an average rate of 2.6 percent a year, much faster than the 1.6 percent average annual increase experienced over the previous two decades.[1] This allowed the U.S. economy to grow more rapidly, and with less inflation, than most economists dared to predict five years ago.

Economists Stephen Oliner and Daniel Sichel estimate that at least two-thirds of the increase in the growth rate of labor productivity since 1995 is due to heavy investment in computer hardware, software, and communication technologies, and the rapid improvement of those technologies. Their study shows that, since 1990, investment in computer software alone has contributed more to growth in labor productivity (in fact twice as much) than all investment in capital excluding information technology.

Advances in computer software, combined with large investments in computing and communications hardware, are enabling the rapid expansion of an entirely new medium of commerce — the Internet. While e-commerce accounts for only a small share of economic activity today, it is growing many times faster than the bricks-and-mortar economy. One of its most important applications is in financial services. Already a significant volume of securities trading is initiated by orders placed at a web site. Internet banking and electronic bill payment are predicted to grow rapidly over the next decade.[2]

[1] This calculation is based on the Bureau of Labor Statistics index of labor productivity in the nonfarm business sector of the economy for the periods 1976-95 and 1996-99.

Competition in this new medium is intense. Naturally, companies are looking for ways to enhance or protect their market position. Increasingly, they are turning to patents to protect their investments in computer software and even their business models. According to the U.S. Patent and Trademark Office, fewer than 100 Internet-related patents were issued prior to 1992. Over the next five years, the patent office granted 750 Internet-related patents. In 1999 alone, it granted nearly 4000 Internet-related patents.[3] Only a decade ago virtually none of these patents would have been granted, and few companies would have bothered to file an application. What happened?

PATENTS ARE NOT FOR ALL INVENTIONS

The American patent system is designed to reward inventors that make new and useful discoveries (see *Patent Basics*). But our patent laws include certain limitations that preclude the patenting of some inventions.[4]

[2] So far, growth in these services has been disappointing. In an article in the *Business Review,* Loretta Mester examined a number of factors that explain why adoption of these new payment methods is likely to be initially slow. These include large up-front costs for deployers; network effects, which limit consumer interest in a payment method until its widespread adoption; and the balance of risk and benefits of a new payment method as compared to existing ones.

[3] Computer and telecommunication equipment manufacturers and software developers own most of these patents. But here are just a few of the interesting exceptions to the rule: Walker Asset Management (owners of the Priceline patent and 24 others), Citibank (15), Incyte Pharmaceuticals (the firm responsible for mapping a significant part of the human genome, 9 Internet patents), Merrill Lynch (9), Amazon.com (7), VISA International (7), Chase Manhattan (6), Andersen Consulting (5), E-Stamp Corp. (4), and Cybercash (one of the first developers of e-cash, with 3 patents).

[4] The U.S. law of patents can be found in Title 35 of the U.S. Code (http://uscode.house.gov/usc.htm), which incorporates all of the various patent statutes enacted over the years.

Patent Basics

For over 200 years, the U.S. government has used patents to reward inventors for their discoveries.[a] The reward is a grant of the legal right to exclude others from making, using, or selling the patented invention for a limited period of time. But monopolies imply higher prices and, thus, less consumption of patented products or processes, which is socially wasteful. A golden rule, then, is that patents should be granted only for discoveries that are really new.

While economists favor the establishment of well-defined property rights, they also recognize that doing so entails some cost—at a minimum, the cost of resolving any disputes that may arise. That is one reason most countries go a little further, granting patents only for inventions that are not trivial extensions of what is already known (the legal concept is called nonobviousness). What's more, the monopoly granted ought to cover only what the inventor discovered and no more. But to do so, the inventor must describe the invention in sufficiently precise terms. If that description is made available to the public, granting patents can assist in the more rapid dissemination of technological knowledge.

Each of these features is embodied in the American patent system, which involves inventors, specially trained attorneys, the U.S. Patent and Trademark Office, and the federal courts. An inventor typically obtains the services of a patent attorney to undertake the process of applying to the patent office for a patent on his or her invention. The patent application will contain a description of the invention, a discussion of any related inventions or techniques known to the inventor (what is called the *prior art*), and a set of proposed claims that will define the property rights he or she is seeking. Examiners at the patent office review the application, conduct their own search of the prior art, decide whether to grant a patent, and if so, specify the precise language of the patent's claims. In essence, the inventor and the patent office negotiate a custom-designed property right tailored to reflect what was invented.[b] But a patent can be granted only when an invention satisfies the requirements set out in the patent statute, as interpreted by federal courts.

An inventor who disagrees with a patent examiner's decision may choose to refile the application and have it reconsidered, or appeal the decision to an administrative panel and, from there, to a federal appeals court. If a patent is granted, and the owner feels the patent is being infringed, he or she can sue the offending party in a federal court. The patent holder can seek a court order prohibiting any further infringement (an injunction) and compensation in the form of lost profits or a reasonable royalty. Defendants in a patent suit typically argue they did not infringe the patent and that the patent is invalid, that is, the patent office made a mistake when it decided to grant the patent. The federal courts decide these cases on the basis of their precedents and the language of the patent statute. Some infringement cases are settled before a verdict is reached. This typically involves a licensing agreement whereby the defendant agrees to pay for the right to use the invention or to license some of its own patented technologies to the other party.

[a] The first U.S. patent was granted in 1790 to Samuel Hopkins of Philadelphia, who invented a new way of making potash (used in soap, glass, and gun powder).

[b] The patent office's online database of patents can be found at its web site: http://www.uspto.gov.

Patentable Subject Matter. Assuming the criteria described in the next section are also satisfied, any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement of these things, can be patented. These categories are quite broad, but the courts have identified certain types of subject matter that cannot be patented, including laws of nature, physical phenomena, and abstract ideas. Prior to 1980, most patent attorneys believed these exceptions precluded the possibility of patenting computer software or methods of doing business.

Patentability Criteria. To qualify for patent protection, an invention must satisfy the requirements of *utility, novelty,* and *nonobviousness.* Utility simply means that the invention is useful. Novelty means the invention is truly something new. An invention fails the test of novelty if before the inventor applied for a patent something very much like it already existed or was described in print. Existing products or processes, existing patents, or articles on the subject in technical publications are called the "prior art."

The requirement of nonobviousness goes a bit further than the requirement of novelty. A patentable invention must be something more significant than a trivial extension of the prior art. In hindsight, an invention may seem pretty obvious, but that is not the standard used in patent law. Patent law asks, would the invention have been obvious, at the time it was made, to a person with ordinary skill in the field and with knowledge of the relevant prior art? If the answer is yes, the invention is obvious and a patent will not be granted.[5]

CAN I PATENT THAT? WELL, NOW YOU CAN

Over the last two decades, the American patent system has changed in many ways. The definition of patentable subject matter has gradually been expanded, reversing the traditional view that computer programs and methods of doing business were unpatentable. In addition, patentability criteria have become less strict. These trends arose from a series of court decisions beginning in the early 1980s. Their effect has been amplified by certain other changes, described below. The result is a patent system that operates very differently than it did 20 years ago.

The Early Years. In the 1960s and early 1970s, computer programs enjoyed very limited intellectual property protection. And it was widely believed that patent protection for computer programs was unavailable. This impression was bolstered by a 1972 Supreme Court decision (Gottschalk v. Benson) involving an application to patent a computer program that translated decimal numbers into binary numbers. The court concluded the program was a mathematical algorithm, which, like laws of nature or an abstract idea, does not fall into one of the categories of patentable subject matter.

In the 1960s and early 1970s, computer programs enjoyed very limited intellectual property protection.

This lack of protection did not matter as much then as it does today. At the time, most computers and computer programs were custom-designed. As a result, most computer programs would not work on another machine without significant modification. Also, companies developed more of their own computer programs and limited outsiders' access to their code. In this environment, firms could protect their programs as *trade secrets,* using state law to prosecute those who stole the code or disclosed it to the public.[6]

When the computer industry began moving away from custom-designed machines, toward standardization and mass production, more computer programs would run on more machines. Firms began to purchase more software "off the shelf," and more firms began to develop software with the intention of selling it to as many customers as possible. But when a company widely distributes a computer program, protecting it as a trade secret becomes more difficult.

As trade secret protection became less effective, a number of firms began to seek other legal protections. After many years of study and debate, Congress modified the Copyright Act in 1980 to explicitly extend copyright protection to computer programs. But by the early 1990s, it was clear that copyright afforded relatively narrow protection for software, allowing rivals to offer very similar products without infringing the copyright. Some firms sought broader forms of protection from imitation. What they eventually got was patent protection for computer programs.

Computer Programs Become Patentable Subject Matter. Long before the meaning of copyright protection for computer programs was well defined, the Supreme Court opened the door to the possibility that computer programs could be patented.[7] In a 1981 decision (Diamond v. Diehr), it ruled that an invention using temperature sensors and a computer program to calculate the correct curing time in an otherwise conventional process of molding rubber goods could be patented. The patent office had rejected the patent application, arguing the only new aspect of the invention was the computer program, which repeatedly solved a well-known chemical equation using the temperature data provided by the sensors. The Supreme Court disagreed, arguing that the invention was an improved process for making rubber goods that happened to use a computer program. Thus, the

[5] A more detailed discussion of the nonobviousness requirement can be found in my previous article in the *Business Review.*

[6] The key to asserting trade secret protection is demonstrating that substantial precautions were taken to prevent the secret from being disclosed. See the article by Friedman, Landes, and Posner. Since that article was written, the Economic Espionage Act of 1996 (18 U.S.C. 831-9) created new federal criminal penalties for certain instances of misappropriation of trade secrets.

[7] The Supreme Court later argued it had never ruled that all computer programs were unpatentable, only that the computer programs involved in the early cases were not patentable.

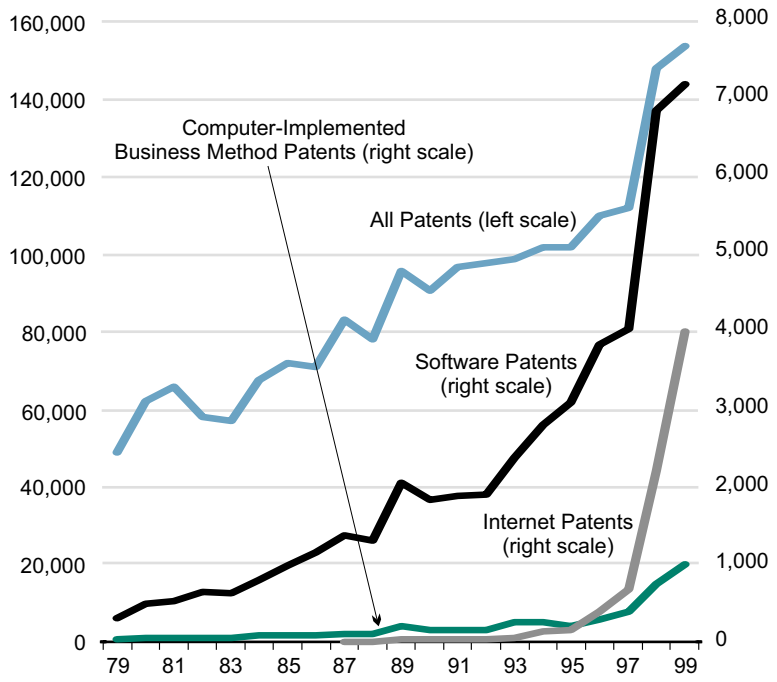
court seemed to distinguish between mathematical algorithms per se and the application of an algorithm to accomplish something useful, concrete, or tangible.[8] Patent attorneys learned to write software patent claims to emphasize the idea of physical transformations that produce useful, tangible results. They also began to write patent claims in terms of a computer program embedded in a machine (that is, a digital computer). Over time, both approaches gained acceptance at the patent office and in the courts.

More recent court decisions place more emphasis on the importance of generating useful results than on producing concrete or tangible results. The link to physical transformations has also become less important. A 1994 decision (in re Alappat) upheld the patentability of a computer program that smoothes digital data before displaying it as a waveform on a computer monitor. The patent office rejected the application, pointing out the lack of any physical transformation of matter. The court disagreed, arguing the invention, a computer programmed to compute averages in a particular way, was a machine and therefore patentable subject matter. It now appears that only computer programs producing the most abstract outcomes are at risk of falling outside the categories of patentable subject matter.[9]

Inventors clearly noticed this change, and the number of software patents issued increased dramatically after 1994 (Figure), much more so than the overall increase in patents granted. Many of the firms that are most prolific in patenting computer programs are not software companies per se. Rather, they are the leading manufacturers of electronics and computing devices.

What About Methods of Doing Business? Until very recently, the conventional wisdom was that business methods did not fall into the categories of patentable subject matter. But this conclusion was never as absolute as it is frequently described, especially in the popular press. The

FIGURE
Patents Granted in the U.S.



Source: U.S. Patent and Trademark Office and author's calculations.

Notes: The chart uses data reported for calendar years. *All patents* are all patents on inventions. This count exludes design and plant patents. The remaining categories are not mutually exclusive, nor are they very precise. The category *Internet* is based on a keyword search conducted by the patent office in July 2000. The category *computer-implemented business methods* is based on the author's search for patents falling into patent classification 705 (data processing: financial, business practice, management, or cost/price determination) conducted in October 2000. The category *software* is based on a count of patents falling into certain classifications (364, 395, 700-7, 713-4, and 716-17), according to patent office statistics released in April 2000.

The exact number of software patents in existence is a subject of considerable debate. The U.S. patent classification system does not divide inventions into those that are exclusively software and those that are not. The ubiquity of computer programs and the frequency with which software is closely integrated with specific hardware make such a distinction difficult to implement, even if it were not misleading. The count provided above is based on the patent classes that clearly account for many types and uses of software. But some of these classes also include inventions we would typically describe as hardware. And software programs classified elsewhere are excluded from this count.

According to the approach used by the author, the patent office has granted roughly 50,000 software patents since 1978. A keyword search for the terms *computer program* or *software* would turn up about 120,000 patents issued since the early 1970s. It is likely that the count shown in the figure exaggerates the number of software patents issued in earlier years while missing many more issued in recent years.

[8] This distinction is not new. A century before computer programs, American courts concluded that new ways of making a machine, manufacture, or composition of matter (that is, processes) were indeed patentable. The distinction – between a patentable process versus the law of nature, or abstract idea, that makes the process work – often turned on whether the process involved a physical transformation of matter.

[9] In recent law review articles, John Thomas and Arti Rai have argued that the current method of determining if a computer program qualifies as patentable subject matter has been reduced to a single question: "Is the program useful?"

patent office, for example, recently identified 41 instances of what it calls financial patents issued *before 1848*.[10]

The modern variety of this kind of patent usually involves a computer. An early example of what the patent office now calls "computer-implemented business methods" is Merrill Lynch's development of the cash management account in the 1970s. This system involved three accounts linked through a computer program. In 1982, Merrill Lynch obtained a patent on the computer system and the software to implement its cash management account. Rival Paine Webber sued to invalidate the patent, arguing that the invention was an unpatentable business method. But a federal court disagreed, concluding that Merrill Lynch's invention "…effectuates a highly useful business method and would be unpatentable if done by hand."

By the early 1990s, the patentability of computer software was clearly established. What's more, development of commercial applications of the Internet exploded. Suddenly, everyone was developing a business model, which typically involved using computers and software to conduct old forms of business in new ways. So it is hardly surprising to find that the number of applications for computer-implemented business methods has grown rapidly in the last few years, and the patent office is granting more and more of these patents (see *A Few Patents Involving Computer Software or Business Methods*).

Any doubt about the viability of patenting a business method that relies on computer hardware and software was eliminated in a single court decision in 1998 (State Street v. Signature Financial Group). In that decision, the court doubted that a precedent establishing an exception for business methods had ever existed. Even if there was one, the court concluded it was irrelevant under current patent law. The patentability of a business method, according to this decision, depends on whether the claimed invention is useful, new, and nonobvious.

> Twenty years ago, it was not uncommon to see patents invalidated by federal courts.

But Patentability Criteria Were Also Relaxed. Twenty years ago, it was not uncommon to see patents invalidated by federal courts, often because the claimed invention was found to be obvious in light of the prior art. There was also at least the appearance that patent cases were being decided differently in different parts of the country. Some policymakers felt the U.S. was losing ground to other countries in certain high technology industries and the patent system was to blame. Each of these concerns contributed to the decision in 1982 to create a new court (the Federal Circuit) to hear all appeals of patent and certain other cases. It was hoped that a single appeals court would reduce any unequal treatment of patent cases in the different district courts and that, by hearing patent cases more regularly, the court would be able to develop greater expertise in a highly specialized area of law.

The decisions of this new court soon altered the landscape of U.S. patent law.[11] The most significant change was the modification of the test for determining the obviousness of a claimed invention. The new court was more willing to rely on secondary factors, such as evidence of commercial success, to indicate that an invention was nonobvious. In practice, the new test is much easier to satisfy than the one used over the previous quarter century and, as a result, many more inventions now qualify for patent protection.[12]

Other Important Changes. In another change, the new appeals court strengthened the presumption that the patent office was correct in issuing a patent.[13] As a result, more evidence is required to invalidate a patent. Other decisions made it easier for a patent holder to obtain a preliminary injunction — a court order prohibiting a potentially infringing activity before the question of infringement is definitively decided by the court.[14] If we compare trial outcomes before and after 1982, we find that courts are much less likely to invalidate patents and more willing to issue preliminary injunctions.[15]

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[10] That number is cited in the recent USPTO White Paper. It includes two patents on bank notes, two patents on financial instruments, four patents on checks, and five patents on interest-calculation tables. The White Paper also cites a patent, issued in 1907, for an insurance system.

[11] For additional detail on these changes, see my 1999 Working Paper and my previous article in the *Business Review*.

[12] Were these changes important? In 1994 Ronald Coolley argued that "many patent attorneys believe that the obviousness defense is dead and that the cause of death lies in the decisions of the Court of Appeals for the Federal Circuit." In 1991, Lawrence Kastriner claimed that "as a result of these changes, patents today are more likely to be held valid than, perhaps, at any time in our history." The title to his article, "The Revival of Confidence in the Patent System," conveys the sense among some observers that a broken system had been repaired by the decisions of the Federal Circuit. Other observers would disagree. See, for example, John Barton's article.

[13] Prior to 1986, federal courts frequently decided the validity of a patent based on whichever side presented more convincing evidence (*a preponderance of the evidence*). In 1986, the Federal Circuit ruled that a patent is presumed to be valid until proven otherwise by *clear and convincing evidence*, a more difficult standard to satisfy. See *Medtronics Inc. v. Intermedics, Inc.* and *Hybritech Inc. v. Monoclonal Antibodies Inc.*

[14] Before 1982, federal courts would not grant a preliminary injunction if they had any reasonable doubt about the validity of the patent in question. The Federal Circuit relaxed this evidentiary standard.

[15] The articles by Adam Jaffe, M.A. Cunningham, and Donald Dunner and his colleagues review quantitative evidence of the change in trial outcomes.

A Few Patents Involving Computer Software or Business Methods

One-Click Purchasing on the Internet

In 1999, Amazon.com obtained a patent (no. 5,960,411) for a computer program that stores a customer's address and credit card number in a database; the program allows the customer to make a purchase with a single mouse click. Amazon's rival, Barnes and Noble, implemented a similar system at its web store. In December 1999, Amazon obtained a preliminary injunction, preventing Barnes and Noble from using a one-click ordering process on its web site. Barnes and Noble added an extra click to its ordering system and had the injunction thrown out on appeal in January 2000.

"Name Your Own Price" Purchasing on the Internet

In 1998, Walker Digital, Inc. obtained a patent (no. 5,794,207) on a computer system and software that enable reverse auctions over a communications network. This is the most famous of the many computer-implemented business methods patented by Walker Digital. Why? Because it is the patent behind Priceline.com's "name your own price" reverse auction system for selling airline tickets, hotel rooms, and car rentals. Soon after obtaining the patent, Priceline sued Microsoft's Expedia travel service for infringement. Another company, Marketel International, sued Priceline, alleging the patented technology was developed by its employees and not Walker Digital. In January 2001, Priceline and Expedia reached a licensing agreement.

Delivering Music Over a Communications Network

InTouch Group owns patents (nos. 5,237,157 and 5,963,916) on a method of delivering portions of pre-recorded music at kiosks and over the Internet. It recently sued Amazon.com and three other companies that allow customers to sample songs contained in CDs for sale on their web sites.

The Cash Management Account

In 1982, Merrill Lynch received a patent (no. 4,346,442) on a computer system and software that enabled financial transactions for the cash management accounts it offered to investors. It was actually a set of three accounts, which included features typically associated with a checking account. Unlike most patents of this sort, it has been tested by litigation. Paine Webber sued Merrill Lynch to invalidate the patent on the grounds that the computer program was an unpatentable algorithm and the cash management system was an unpatentable business method. A federal district court rejected both of those arguments.

The *CollegSure* CD

In 1989, New Jersey's College Savings Bank obtained a patent (no. 4,839,804) on its special certificate of deposit, which pays a return commensurate with the increase in the cost of college tuition. Shortly after obtaining the patent, the bank sued CenTrust Savings Bank for infringement. The case was settled prior to trial after CenTrust agreed to pay licensing fees to College Savings Bank.

A Data Processing System for Managing Mutual Funds

In 1993, Signature Financial Group obtained a patent (no. 5,193,056) on a data processing system that enabled a "hub and spoke system" for mutual funds. The system allowed a fund manager to aggregate the assets of several mutual funds into a single portfolio, reducing overhead costs while maintaining the necessary transaction information for allocating gains, losses, and tax liabilities to the original mutual funds. State Street Bank and Trust sued Signature Financial to invalidate the patent. It succeeded in the original trial, where the judge concluded that Signature's computer program was an unpatentable algorithm as well as an unpatentable business method. Both of those conclusions were decisively reversed on appeal in 1998.

Automated Life Insurance Underwriting

The technology affiliate of the insurance company Lincoln Re is suing a software company, Allfinanz, for patent infringement. Allfinanz has a system that issues a temporary life insurance policy at a bank branch within 30 minutes. Lincoln Re alleges this system infringes two patents it has obtained for automated risk assessment and decision making. The company is seeking an injunction and damages.

Internet Banking

In 2000, S1 (formerly Security First Network Bank) obtained a patent on its three-tier financial transaction system. It is suing the company Corillion, a developer of Internet banking software used by several dozen large financial institutions. There are at least two dozen patents that involve online banking. Microsoft owns at least one of them.

ARE THESE NEW PATENTS GOOD OR BAD?

A patent system is a reward system developed to encourage inventors to invest the time and resources to make valuable discoveries. But, by creating temporary monopolies, patents also have social costs. In particular, consumers must pay more than the marginal cost of the new product or process, which results in too little use of the innovation (see *Patent Basics*). There are also transaction costs associated with determining the validity of patents and instances of infringement, plus the costs associated with negotiating licensing agreements. Has extending patent protection to computer software and business methods increased the rate of innovation? Is that increase worth the social costs associated with these patents?

Are the New Patents Stimulating Innovation? Between 1995 and 1998, spending on research and development (R&D) by firms in the computer programming and data processing industry increased 67 percent, reaching $14.3 billion. The industry accounted for 10 percent of all private spending on R&D, one-third of all R&D spending by nonmanufacturing firms, in 1998. Employment of scientists and engineers by the industry, another measure of research activity, increased 59 percent, to 123,000. That was more than 12 percent of all scientists and engineers employed by industry (36 percent of those employed by nonmanufacturing firms) in 1998.[16]

As impressive as these numbers are, they largely reflect the rapid growth of the industry, whose sales rose 65 percent between 1995 and 1998.[17] Another way to evaluate these trends is to examine the ratio of R&D spending to sales, which is a measure of the research intensity of an industry. A high ratio might imply there are potentially many new products or processes that are worth exploring.[18] The ratio of R&D spending to sales for publicly traded companies in the software and data processing sector has increased from about 5 percent in the early 1980s to about 7.5 percent in recent years.[19] Most of that increase occurred prior to the 1990s, a time when the patentability of computer programs was still uncertain. The percent increase in R&D intensity for this sector (59 percent) between 1980 and 1999 is comparable to the overall trend for publicly held companies (56 percent).

We have far less information about research activity in the financial services sector than in other parts of the economy. We do know that R&D spending and employment of scientists and engineers are tiny relative to total industry revenues and employment. But we also know that both have increased rapidly in recent years. Between 1995 and 1998, R&D spending in the financial services sector more than doubled, to $1.6 billion, and employment of scientists and engineers more than tripled, to 17,500.[20]

It is important to remember that patents in these industries are a recent phenomenon. The patentability of computer software was established less than a decade ago. The patentability of business methods was only clearly established in 1998. Firms in the computer software and financial services industries were innovating rapidly long before it was thought possible to patent their innovations, yet they found effective ways to exploit their innovations without patents. This makes the availability of patent protection an unlikely explanation for the software revolution. It is even less likely that patent protection played an important role in the rapid financial innovation seen over the last three decades.

More Patents Are Not Necessarily Better. From the standpoint of theory, the claim that more patent protection encourages more R&D, and therefore more innovation, is a qualified one. In economic models where innovations build on each other over time, extending patent protection to less significant innovations can either raise or lower the rate of innovation, depending on characteristics of the industry. [21]

When patentability criteria are fairly strict, there is a significant risk that a discovery will not qualify for protection, which might discourage inventors from undertaking costly projects. If patentability requirements are relaxed, more inventions will qualify for patent protection, possibly reducing the risk of imitation that inventors face. But at the same time, competition between related patented technologies will increase, reducing the profits that patents generate. That would make patents less valuable and possibly reduce the incentive to innovate. In high technology industries, where innovation is already rapid, the first effect is weaker and the second effect is stronger. As a result,

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16 The data on R&D spending and employment of scientists and engineers are from the National Science Foundation's annual survey of industrial R&D for firms contained in the standard industry classification (SIC) 737, which includes developers of custom-designed and prepackaged software, integrators of computer hardware and software, and firms that provide data processing services to other companies.

17 This calculation is based on the Census Bureau's Annual Survey of Service Industries.

18 This interpretation of the R&D/sales ratio can be criticized. Sales tend to change more rapidly than R&D budgets. If previous investments in R&D are very successful, sales growth will accelerate. That would depress the R&D/sales ratio until R&D budgets are revised upward. That is why it is important to examine this ratio over a number of years.

19 The R&D/sales ratio described here is derived from all publicly traded firms classified in SIC 737 in Standard and Poor's Compustat data set.

20 Unlike firms in many other industries, most providers of financial services do not report their R&D spending, so the only available data of this sort come from the NSF survey. The NSF reports totals for firms contained in SIC 60-65 and SIC 67 (the finance, insurance, and real estate sectors). Unfortunately, that survey did not cover the service sector in detail prior to 1995.

21 The ambiguous effect of weaker patentability criteria is found in a number of theoretical models, including those developed by Jim Bessen and Eric Maskin, Ted O'Donoghue, and Olivier Cadot and Steve Lippman.

relaxing patentability criteria is more likely to reduce research activity in industries that are already innovating rapidly.[22]

Declining Patent Quality. Because patents have social costs, they should be granted only for inventions that are really new. Moreover, the property rights conferred by a patent should be reasonably related to what an inventor has actually discovered. It is the job of the patent office to ensure the inventor's claims do not overreach.

It is only natural that the patent office will make more mistakes when evaluating patent applications in a new technology field than in fields it is already familiar with. The patent examiner will not know where to look for the prior art, which will not be found in the records of previously issued patents, and will have more difficulty determining whether an applicant's specification is truly novel or nonobvious.[23] All of these problems appear in the case of computer programs.

The patent office has been widely criticized for issuing patents on garden-variety software technologies. The undisputed black eye occurred in 1993, when it granted a patent to Compton's Encyclopedia for a multimedia search and retrieval system. Unfortunately, the patent office was unaware of a great deal of prior art, including prior patents. The commissioner soon ordered the patent to be reexamined, and all its claims were eventually rejected.[24] Unfortunately, the patent office is apparently reliving the experience. In 1998, it issued a patent for a method to eliminate problems associated with the year 2000 date change in computer programs. Again, there was an outcry that the patent covered techniques widely used for many years. And, again, the commissioner announced that the patent would be reexamined.[25]

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Some argue that the worst patents do not matter because no one would ever try to enforce them. But the real concern is that these examples signal a large quantity of important, but poorly examined patents that could lead to increased litigation, which is very costly.[26] But for every critic of these patents, there are others who justify them as a means of protecting small start-up firms or a new source of revenues for established ones.

A Patent Arms Race? The nature of innovation and recent patenting activity may also increase the potential costs associated with poor patent quality. In the computer software industry and many other high technology industries, innovation tends to be cumulative — that is, inventions tend to build on one another. As more and more of these inventions are patented, firms are finding they need to cross-license technologies, often from rivals. In the background there is always the fear that a preliminary injunction will delay a product's introduction. In a fast-moving industry, a few months' delay can doom even a state-of-the-art product.

In this environment, firms may find themselves in a "patent arms race." This has both defensive and offensive qualities. On the one hand, firms believe they must patent as much as possible to prevent rivals from obtaining patents that might threaten commercialization of their inventions. Even when this strategy fails, the firm is likely to have a larger stock of proprietary technologies to trade in cross-licensing agreements with their rivals.[27] On the other hand, a well-constructed "patent thicket" can be used to raise barriers to entry, particularly for start-up firms.

At nearly the same time that computer-related inventions became patentable, the federal courts raised the presumption that the decisions of the patent office were correct. Litigants must now produce more evidence to overcome this presumption, which increases the cost of invalidating erroneous patents. In addition, the courts are more willing to grant preliminary injunctions than in the past, which increases the risk that a firm can be erroneously locked out of the market for a new good or service.

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[22] This somewhat counter-intuitive result is demonstrated in my 1999 Working Paper and explained in more detail in my 1999 *Business Review* article.

[23] At this point in the application process, the burden of proving that the claimed invention is obvious lies with the examiner. If the applicant is aware of any relevant prior art, he or she is obligated to disclose it in the patent application or risk having the patent invalidated. But applicants are not obliged to conduct a thorough search of the prior art before applying for a patent.

[24] Patent no. 5,241,671. See the article by E. Robert Yoches.

[25] The patent in question is no. 5,806,063 (Date Formatting and Sorting for Dates Spanning the Turn of the Century), granted to Bruce Dickens. The reexamination was ordered in December 1999.

[26] John Barton cites a recent American Intellectual Property Association survey, which found that litigating a typical patent infringement suit through the trial stage generated $3 million in legal costs.

[27] In the mid 1990s, Wes Cohen and his colleagues asked over 1000 U.S. manufacturing companies why they patented their inventions. The following answers are ordered by how frequently they were cited: to prevent copying (96 percent); to prevent rivals from obtaining blocking patents (82 percent); to prevent infringement suits (59 percent); and to use in negotiations with other firms (47 percent). The percentages in parentheses are for product innovations. The order is the same for process innovations, but the percentages are lower. Bronwyn Hall and Rosemarie Ham Ziedonis also found that these factors were important in explaining the surge in patenting by American semiconductor firms.

This may be a prescription for more litigation, and it may deter smaller firms from entering certain markets, thereby reducing competition.

But It's Not Clear-Cut. There are a few countervailing arguments to consider. First, while we should be concerned about the possibility of technological bottlenecks, we cannot be certain they will happen. Firms may develop more efficient ways to cross-license their proprietary technologies. For example, the copyright collectives ASCAP and BMI coordinate the collection and distribution of royalties for music played on the radio. A number of web sites that would facilitate patent licensing are already in development. Another approach is the formation of institutions that pool the intellectual property rights of their members. This is not a new idea—patent pools have been used to resolve technology bottlenecks in a number of industries. But any attempt to construct a patent pool will come under scrutiny by the Justice Department, which will be concerned about the possibility of collusion.[28]

Nor do we know how these patents will hold up in the courts. The arguments given above suggest that patent holders are in a strong position. But defendants have a strong incentive to find compelling examples of prior art missed by the patent office. Patents of really poor quality are unlikely to stand up in court. Anticipating this, owners of such patents may not be very aggressive in asserting their rights.[29] Another possibility is that courts will narrow what they see as overly broad claims contained in these patents. Rivals may find that it is easy to "invent around" a narrow patent on a computer program or a business model.[30]

WHAT CAN BE DONE?

Barring significant new legislation or a sudden reversal of course by the courts, patents on computer software and business methods are here to stay. What, then, can we do to maximize the benefits and minimize the costs? It turns out there are many things we can do, but many of the following ideas are controversial.

More Resources. The obvious thing is to make sure the patent office has the resources and expertise required to do quality examinations in these new fields. The patent activities of the office are largely funded through fees charged to process patents and to keep them in force. The rapid increase in patent applications has contributed to a rapid rise in fees, now approaching $1 billion a year. Even with this increase in resources, the patent office spends only about $2700 per patent application processed. The amount of time required to process patents has increased more than 50 percent since 1994 and the backlog of pending patent applications has more than doubled.[31] In certain technology areas, the increase in the number of examiners has not kept up with the increase in applications.

More Information. Many observers have called for the development of databases containing examples of nonpatent prior art that could be made available to patent examiners. The patent office is currently moving away from its paper-based system to an approach emphasizing computerized searches of publicly available databases. But the agency has experienced many technical problems in implementing its new search systems. The patent office and others have called upon the software industry to develop its own database of prior art. Indeed, the Software Patent Institute was founded for this very purpose in 1994, but apparently more needs to be done.

Other ideas are more controversial. For example, suppose we require that before filing for a patent, applicants must conduct a search of the prior art and report what they find in their application to the patent office.[32] This would shift some of the burden of discovery back to the inventor. The problem is how such a requirement might be implemented. How do we set a standard for a minimally acceptable search of the prior art? How would foreign applicants comply? Do we want the patent office to be swamped with printouts from 250,000 web searches?

Currently, most of the burden of identifying relevant prior art lies with the patent office. Some scholars propose adopting an opposition system – an administrative process whereby a third party can dispute a patent either just before or just after it is issued.[33] The idea is to use the self-interest of

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[28] Robert Merges' 1996 article describes how these arrangements work to reduce the transaction costs associated with sharing copyrighted content or patented technologies. But he also points out that ASCAP has operated under an antitrust consent decree since the 1950s.

[29] But there remains a legitimate concern that some patent owners will have an incentive to file nuisance suits if they believe that defendants will find it cheaper to settle rather than pursuing an expensive victory in court.

[30] For example, just before Christmas 1999, Amazon.com successfully sued to prevent Barnes and Noble from using a one-click ordering system on its web site. While this was an embarrassing defeat in court, Barnes and Noble simply added a second mouse click to its program. Unisys holds a patent on a data compression technique integral to the GIF format often used for pictures on web pages. Its attempts to secure licensing revenues from this patent stimulated the adoption of new compression formats.

[31] The number of applications awaiting action by an examiner increased from 107,000 in 1994 to 243,000 in 1999. In 1994, the average patent application took 16 months to process. In 1999, the average processing time was 25 months. The delay is worse in certain technology fields. It took an average of 31 months to *issue* a patent on communications or information processing technology compared to an average 26 months for all technologies. It should be noted that, throughout the 1990s, a share of the fees the patent office collects has been diverted to the Treasury. That share has grown significantly in recent years.

[32] Currently, it is not uncommon for applicants to search the prior art, but the motivation is self-interest rather than any binding legal obligation.

[33] See Robert Merges' 1999 article.

customers or competitors to generate more information than the patent office is able or willing to produce, which could improve the quality of patents. Opposition systems have been used for many years in Europe and, until recently, Japan. But they are not universally supported because the evidence presented may be biased and third parties may have an excessive interest in contesting patents, even good ones.

Change the Standards Used by the Courts? Recall that during the 1980s, the courts began to require clear and convincing evidence that a patented invention did not meet the statutory requirements before invalidating the patent. Many legal practitioners and scholars supported a more stringent burden of proof, arguing that the courts had been all too willing to second guess the patent office during the 1970s.

But today, it is not unreasonable to ask whether, for patents in new technology fields, the courts should be more skeptical about the quality of patent examinations. In that case, we may wish to return to the previous evidentiary standard (a preponderance of the evidence) when evaluating patents on technologies unfamiliar to the patent office. It would also seem prudent for courts to be more circumspect about granting preliminary injunctions before reaching a final conclusion about a patent's validity.

Stricter Patentability Criteria Would Help. One way to reduce the effect of issuing more erroneous patents is to adopt a more stringent test for nonobviousness. Under a more rigorous test, the fact that certain prior art was missed is less likely to affect the examiner's final decision. Nor is it at all clear that adopting more rigorous patentability criteria would adversely affect the incentive to innovate. As discussed in the previous section, there is little evidence that moving to weaker patentability criteria in the 1980s led to more innovation.[34]

[34] See Adam Jaffe's review paper.

Small Changes Are Already Being Made. Recognizing that certain problems exist, the patent office is not standing still. It is developing special rules for examining patents in the areas of computer software and business methods. It is hiring new examiners trained in these fields and developing contacts with a variety of trade associations. It has also requested additional resources.

In 1999, Congress enacted a special prior use defense for patents on "methods of doing or conducting business." Under this defense, a firm that was using a business method, but had not disclosed it (because it was a trade secret), cannot be found to infringe the patent.[35] The usefulness of this exception is unclear, in part because the definition of "business method" must be established through litigation. Nor is it clear that encouraging firms to conceal innovative business practices or reducing the incentive of firms to dispute invalid patents would be socially beneficial.[36]

[35] Section 4302 of the American Inventors Protection Act (Public Law 106-113), enacted in 1999. A patent cannot be invalidated by the existence of an earlier instance of the invention when it is concealed, as it must to be protected as a trade secret.

[36] James Barney examines these and other issues in his recent article. One unanswered question is whether the prior use exception would apply in cases alleging infringement of a patent on computer software that implements a business method.

CONCLUSION

The traditional rationale for granting patents is that they are a reward to inventors and, as such, spur innovation. But this does not mean it is always better to have more patents. We don't know whether extending patent protection to computer programs and business methods implemented via computers will stimulate innovation in the software industry or, for that matter, the development of financial services on the Internet. But there are good reasons to expect that such patenting will not provide a whole lot more incentive to innovate than these firms already have. And it may well be the case that the costs associated with enforcing, licensing, or invalidating these patents could be higher than we have seen in other industries and in other eras.

We can do a number of things to minimize the problems associated with these patents and to maximize their benefits. We can at least take steps to improve the quality of patents being issued. This may involve additional resources, but it may also require a structural change in our patent process. And we should do more careful empirical research on the effects of increasing the availability of patents in high technology industries. This would give policymakers more and better information about the costs and benefits of the ongoing changes in our patent system.

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