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Patents and Innovation: Issues in Patent Reform

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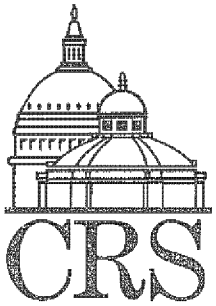

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ABSTRACT

Changes to existing patent law have been considered over the past several congresses. Much of the expressed interest arises from the perception of patent ownership as an incentive to innovation, innovation being the basis for technological progress, one significant factor in economic growth. This paper looks at the role of patents in innovation and provides a discussion of the proposed alterations to current practices within the context of issues associated with the commercialization of new products and processes. The report will be updated as warranted by legislation and provides background information that may be helpful during debate on this topic in the 106th Congress.

Patents and Innovation: Issues in Patent Reform

Summary

The on-going debate over changes to existing patent law has continued in the 106th Congress. Much of the expressed interest arises from the perception that patent ownership is an incentive to innovation. Innovation, the process that ultimately provides new and improved products, manufacturing processes, and services, is the basis for technological progress. This technological advancement is a key element of economic growth.

The patent system was created in the United States Constitution. Article I, Section 8, Clause 8 states that "The Congress Shall Have Power . . . To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries . . . ." The award of a patent permits the creator of an idea to exclude others from use of that concept without compensation. The patent process also places the information associated with an invention in the public domain by requiring publication of the application upon award.

Patents are intended to provide an incentive to encourage the investment necessary to develop an idea and bring it to the marketplace embodied in a product or process. However, not everyone agrees that the patent system is a particularly effective means to stimulate innovation. While patents allow the inventor to obtain a larger portion of the returns on resource expenditures, they do not permit him to capture all the benefits Patents can be circumvented and infringement cannot always be proven. It appears that the efficacy of patents is perceived differently among individual industrial sectors.

The proposed changes that might significantly alter the relationship between innovation and patents involve the requirement for mandatory publication of patent applications 18 months after filing. Innovation typically is knowledge-driven. It also produces knowledge. How information is treated in the patent process is therefore of major consequence. Advocates of early publication claim that it offers a way to accelerate information dissemination, provide background on current technology, avoid costly duplication of effort, and highlight areas of scientific and technological interest. Opponents contend that such requirements will allow competitors to interfere with the award process to the detriment of inventors, particularly small companies. As the debate continues, it might be helpful to explore the balance between protection of the inventor and disclosure of information, if innovation is the ultimate objective.

This report provides background information on the relationships between patents and innovation that may be useful during consideration of this issue in the 106th Congress. The paper will be updated as warranted by legislative activity.

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Patents and Innovation: Issues in Patent Reform

Introduction

Changes to existing patent law are being considered by the 106th Congress. This would build upon previous legislative efforts aimed at providing additional autonomy to the Patent and Trademark Office and altering requirements for publication of information contained in a patent application. Much of this interest is founded upon the perception that patent ownership is an incentive to innovation, the basis for the technological advancement that leads to economic growth. It is through the commercialization and use of new products and processes that productivity gains are made and the scope and quality of goods and services are expanded. To assist in the debate over patent reform, this paper explores several of the significant issues, particularly the role of patents in stimulating invention and the relationship between patents, innovation, and economic growth.

The patent system was created by Article I, Section 8, Clause 8 of the U.S. Constitution to encourage new discoveries and their reduction to practice, commonly known as innovation. Patent ownership is intended to stimulate the investment necessary to develop an idea and bring it to the marketplace embodied in a product or process. The award of a patent provides the recipient with a limited-time monopoly over the application of his discovery in exchange for the public dissemination of the information associated with the patent application. This is intended to permit the inventor to receive a return on the expenditure of resources leading to the discovery. The requirement for publication of the patent is expected to stimulate additional innovation and other creative means to meet similar and expanded demands in the marketplace.

Legislation considered in the 105th Congress contained provisions that would alter the information dissemination process, a crucial factor in the perceived utility of patenting.[1] In the current Congress, H.R. 1907, the American Inventors Protection Act, passed by the House on August 4, 1999, also addresses early publication of material contained in patents. It is anticipated that the debate will continue on this and similar bills incorporating changes that could have significant impacts on the relationship between patents and innovation. At issue is whether or not the new procedures would influence the ability of the patent process to generate the technological progress that leads to economic growth. The discussion below provides a context to help decisionmakers assess the potential consequences of any proposals under consideration.

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[1]H.R. 400 passed the House on April 23, 1997; S. 507 was reported to the Senate on May 23, 1997.

Technology and Economic Growth

Technological advancement is a key element of economic growth. Experts widely accept that technical progress is responsible for up to one-half the growth of the U.S. economy and is one principal driving force for increases in our standard of living.[2] Historically, industrial expansion was based on the use of technology to exploit natural resources. Today, such growth tends to be founded on scientific discoveries and engineering knowledge (e.g., electronics, biomedical applications) and is even more dependent than before on the development and use of technology. Technology can drive the economy because it contributes to the creation of new goods and services, new industries, new jobs, and new capital. It can expand the range of services offered and extend the geographic distribution of those services. The application of technologies also can contribute to the resolution of those national problems that are amenable to technological solutions.

Technological progress is achieved through innovation, the process by which industry provides new and improved products, manufacturing processes, and services. It is an activity that may involve, among other things, idea origination, research, development, engineering, commercialization, and diffusion throughout the marketplace. A concept can become an innovation without evolving through those separate steps. An invention becomes an innovation when it has been integrated into the economy such that the knowledge created is applied in production to increase productivity and quality, or results in a new or improved product or service that can be sold in the marketplace. It is only in that phase that a significant stimulus to economic growth occurs.

Innovations do not have to embody a breakthrough in order to have a significant effect. Many of the innovations that further technological advancement are generated as solutions to production and marketing problems rather than opportunities arising from research and development (R&D). The majority of innovations appear to be the result of incremental improvements to existing products or processes. Some of these are based on R&D, but many others are the result of changes in engineering and the production process, or reflect new ideas created by intuition, experience, or skill. The advance of technology provides opportunities for additional new ideas and builds upon the available store of knowledge.[3]

However, research and development are important to technological progress in many ways. It has been argued that the innovations arising from R&D are the most

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[2]Gregory Tassey, *The Economics of R&D Policy* (Connecticut: Quorum Books, 1997), 54. See also: Edwin Mansfield, "Intellectual Property Rights, Technological Change, and Economic Growth," in *Intellectual Property Rights and Capital Formation in the Next Decade*, eds. Charls E. Walker and Mark A. Bloomfield (New York: University Press of America, 1988), 5.

[3]Richard R. Nelson, "What is 'Commercial' and What is 'Public' About Technology and What Should Be?" in *Technology and the Wealth of Nations*, eds. Nathan Rosenberg, Ralph Landau, and David C. Mowery (Stanford: Stanford University Press, 1992), 59.

important ones.[4] Profound changes in our society have been brought about by advances in research, resulting in new products and processes in the areas of medicine, semiconductors, computers, and materials, just to name a few. In addition, R&D contributes to economic growth by its impact on productivity. Over the years various experts studying the effects of research and development have found that productivity growth in an industry or a firm is directly and significantly related to the amount spent previously on R&D in that industry or company.[5] It has been estimated that one-half of productivity increases (output per person) are the result of investments in research and development.[6] "In general, research-intensive industries and industries that are intensive users of technology account for increasingly larger dollar volumes of sales and employment...," according to Gregory Tassey, senior economist at the National Institute of Standards and Technology.[7] Additional recent work supported by the Department of Commerce (using Census Bureau data) has shown that advanced technologies are associated with higher manufacturing productivity, which is in turn related to employment growth.[8]

Studies demonstrate that the rate of return to society as a whole generated by investments in R&D is significantly larger than the benefits that can be captured by the person or organization financing the work. It has been estimated that the social rate of return on R&D spending is over twice that of the rate of return to the inventor.[9] Ideas often can be easily imitated, the knowledge associated with an innovation dispersed and adapted to other products and processes that, in turn, stimulate growth in the economy. That can happen in the absence of appropriability defined as "...factors, excluding firm and market structure, that govern an innovator's ability to capture the profits generated by an innovation."[10] The appropriability of an invention depends on the level of competition in the industry and the type of information related to the innovation; the more competition and the more basic the knowledge, the less

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[4]Ralph Landau, "Technology, Economics, and Public Policy," in *Technology and Economic Policy*, eds. Ralph Landau and Dale W. Jorgenson (Cambridge: Ballinger Publishing Co. 1986), 5.

[5]Alden S. Bean, "Why Some R&D Organizations Are More Productive Than Others," *Research/Technology Management*, Jan.-Feb. 1995, 26. See also: Edwin Mansfield, "How Economists See R&D," *Harvard Business Review*, Nov.-Dec. 1981, 98.

[6]Zvi Griliches, "The Search for R&D Spillovers," *Scandinavian Journal of Economics*, 1992, 29-47.

[7]U.S. Department of Commerce. National Institute of Standards and Technology. *Technology and Economic Growth: Implications for Federal Policy*, by Gregory Tassey, Planning Report 95-3, (Oct. 1995), 19.

[8]U.S. Department of Commerce. Economics and Statistics Administration *Technology, Economic Growth and Employment: New Research from the Department of Commerce*, (1994), 10-11.

[9]For a list of relevant research in this area see: Council of Economic Advisors. *Supporting Research and Development to Promote Economic Growth: The Federal Government's Role*, (October 1995), 6-7.

[10]David J. Teece, "Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing, and Public Policy," in *The Competitive Challenge*, ed. David J. Teece (Cambridge: Ballinger Publishing Co., 1987), 188.

appropriable it is.[11] The difficulty in securing sufficient returns to spending on research and development has been associated with underinvestment in those activities.

While there is general agreement that technological innovation can play an important role in economic growth and productivity, the relationships among these activities are complicated, may be difficult to trace, and often are not fully understood by the experts. Despite methodological problems in measuring technological advance and its components, studies seem to agree that innovation can make a positive contribution to economic growth and productivity; the return to private investment in research and development is often high compared to alternative investments of the firm; and the median social rate of return on investment in R&D is over twice that of the median private rate of return.

The Role of Patents

The role of invention and innovation in technological progress has given rise to various governmental efforts to encourage these endeavors. The first such federal initiative was the creation of the U.S. patent system. Article I, Section 8, Clause 8 of the U.S. Constitution states that "The Congress Shall Have Power ... To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries...." The award of a patent permits the creator of an idea to exclude others temporarily from use of that concept without compensation. It also places the information associated with an invention within the public domain.

Innovation typically is knowledge-driven — based on the application of knowledge, whether it is scientific, technical, experiential, or intuitive. Innovation also produces new knowledge. One characteristic of knowledge that underlies the patent system is that it is a "public good," a good that is not consumed when it is used. As John Shoven of Stanford University points out, "[t]he use of an idea or discovery by one person does not, in most cases, reduce the availability of that information to others."[12] Therefore the marginal social cost of the widespread application of that information is near zero because the stock of knowledge is not depleted. "Ordinarily, society maximizes its welfare through not charging for the use of a free good."[13] However, innovation typically is costly and resource intensive. Patents permit novel concepts or discoveries to become "property" when reduced to practice and therefore allow for control over their use. They "...create incentives that

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[11]Mansfield, *Intellectual Property Rights, Technological Change, and Economic Growth*, 10-11.

[12]John B. Shoven, "Intellectual Property Rights and Economic Growth," in Walker, et. al., *Intellectual Property Rights and Capital Formation in the Next Decade*, 46.

[13]Robert P. Benko, "Intellectual Property Rights and New Technologies," in Walker, et. al., *Intellectual Property Rights and Capital Formation in the Next Decade*, 27.

maximize the difference between the value of the intellectual property that is created and used and the social cost of its creation."[14]

The patent process is designed to resolve the problem of appropriability discussed above. If discoveries were universally available without the means for the inventor to realize a return on investments, there would result a "...much lower and indeed suboptimal level of innovation."[15] While research is often important to innovation, studies have shown that it constitutes only 25% of the cost of commercializing a new technology or technique, thus requiring the expenditure of a substantial amount of additional resources to bring most products or processes to the marketplace. The grant of a patent provides the inventor with a means to capture the returns to his invention through exclusive rights on its practice for 20 years from date of filing. That is intended to encourage those investments necessary to further develop an idea and generate a marketable technology.

Issuance of a patent provides the inventor with a limited-time monopoly that is influenced by other mitigating factors, particularly the requirements for information disclosure, the length of the patent, and the scope of rights conferred. The process of obtaining a patent places the concept on which it is based in the public domain. In return for a monopoly right to the application of the knowledge generated, the inventor must publish the ideas covered in the patent. As a disclosure system, the patent can, and often does, stimulate other firms or individuals to invent "around" existing patents to provide for parallel technical developments or meet similar market needs.

The patent system thus has dual policy goals — providing incentives for inventors to invent and encouraging inventors to disclose technical information.[16] Disclosure requirements are factors in achieving a balance between current and future innovation through the patent process, as are limitations on scope, novelty mandates, and nonobviousness considerations.[17] They give rise to an environment of competitiveness with multiple sources of innovation, which is viewed by some experts as the basis for technological progress. This is important because, as Robert Merges (Boston University) and Richard Nelson (Columbia University) found in their studies,

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[14]Stanley M. Besen and Leo J. Raskind, "An Introduction to the Law and Economics of Intellectual Property," *Journal of Economic Perspectives*, Winter 1991, 5.

[15]Kenneth W. Dam, "The Economic Underpinnings of Patent Law," *Journal of Legal Studies*, January 1994, 247.

[16]Robert P. Merges, "Commercial Success and Patent Standards: Economic Perspectives on Innovation," *California Law Review*, July 1988, 876.

[17]Dam , *The Economic Underpinnings of Patent Law*, 266-267.
Scope is determined by the number of claims made in a patent. Claims are the technical descriptions associated with the invention. In order for an idea to receive a patent, the law requires that it be ". . .new, useful [novel], and nonobvious to a person of ordinary skill in the art to which the invention pertains." See footnote 12, p. 7.

when only "...a few organizations controlled the development of a technology, technical advance appeared sluggish."[18]

Not everyone agrees that the patent system is a particularly effective means to stimulate innovation. It has been argued that patents do not work in reality as well as in theory because they do not confer perfect appropriability. In other words, they allow the inventor to obtain a larger portion of the returns on his investment but do not permit him to capture all the benefits. Patents can be circumvented and infringement cannot always be proven. Thus, patents are not the only way, nor necessarily the most efficient means, for the inventor to protect the benefits generated by his efforts. A study by Yale University's Richard Levin and his colleagues concluded that lead time, learning curve advantages (e.g. familiarity with the science and technology under consideration), and sales/service activities were typically more important in exploiting appropriability than were patents. That was true for both products and processes. However, patents were found to be better at protecting the former than the latter. The novel ideas associated with a product often can be determined through reverse engineering — taking the item apart to assess how it was made. That information then could be used by competitors if not covered by a patent. Because it is more difficult to identify the procedures related to a process, other means of appropriation are seen as preferable to patents, with the attendant disclosure requirements.[19]

The utility of patents to companies varies among industrial sectors. Assessments of the aircraft and semiconductor industries show that patents were not the most successful mechanism for capturing the benefits of investments. Instead, lead time and the strength of the learning curve were determined to be more important.[20] In contrast, patents are perceived as critical in the drug and chemical industries. That may reflect the nature of R&D performed in those sectors, where the resulting patents are more detailed in their claims and therefore easier to defend.[21] The degree to which industry perceives patents as effective is ". . . positively correlated with the increase in duplication costs and time associated with patents."[22] Patents significantly raise imitation costs in certain industries -- an estimated 40% in the pharmaceutical sector, 30% for major new chemical products, and 25% for typical chemical goods -- and are thus viewed as important. However, in other industries, patents have much

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[18]Robert P. Merges and Richard R. Nelson, "On the Complex Economics of Patent Scope," *Columbia Law Review*, May 1990, 908.

[19]Richard C. Levin and Alvin K. Klevorick, Richard R. Nelson, Sidney G. Winter. "Appropriating the Returns for Industrial Research and Development," *Brookings Papers on Economic Activity*, 1987, in *The Economics of Technical Change*, eds. Edwin Mansfield and Elizabeth Mansfield (Vermont, Edward Elgar Publishing Co., 1993), 254.

[20]Ibid., 243.

[21]Ibid., 255 and 257. See also: Mansfield, *Intellectual Property Rights, Technological Change, and Economic Growth*, 12 and 13.

[22]Levin, et.al., *Appropriating the Returns for Industrial Research and Development*, 269.

smaller impact on the costs associated with imitation (e.g. in the 7%-15% range for electronics), and are considered less successful in protecting resource investments.[23]

Despite questions as to their efficacy, firms continue to patent their inventions. In a study of 100 companies spanning 12 industries conducted by Edwin Mansfield, about half of the eligible inventions are patented in those sectors that did not consider patents important. That activity appears to be the result of additional perceived benefits including royalty payments, delays to imitators, and the ability to use patents as bargaining tools to meet alternative priorities of the firm.[24] Others speculate that patents are used primarily to measure employee performance and to gain access to foreign markets.[25] The low expiration rate of high technology patents relative to patents on less sophisticated technologies may indicate the value that companies assign to such protection, even in industries when the life cycle of the invention is short.[26] According to Suzanne Scotchmer (University of California, Berkeley), the innovator's incentives to patent depend on: "(i) the profitability of marketing the first technology prior to the development of second generation products; (ii) the extent of disclosure that patenting entails; (iii) the ease with which the technology could be reverse-engineered if marketed but not patented; and (iv) the breadth of patent protection."[27]

Observations on the Effects of Proposed Changes on Innovation

Several changes to U.S. patent law were debated during the 105th Congress and the issues addressed may provide guidance for current discussions in the 106th Congress. H.R. 400, the 21st Century Patent System Improvement Reform Act, passed the House on April 23, 1997. This bill would have (among other things):

- made the Patent and Trademark Office, now located in the Department of Commerce, a government corporation;
- required disclosure of information contained in patents 18 months after filing (except in the case of small businesses, universities, and individual inventors);

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[23]Edwin Mansfield, Mark Schwartz and Samuel Wagner, "Imitation Costs and Patents: An Empirical Study," *The Economic Journal*, December 1981, in Mansfield, *The Economics of Technical Change*, 270.

[24]Mansfield, *Intellectual Property Rights, Technological Change, and Economic Growth*, 14.

[25]Levin, et. al., *Appropriating the Returns for Industrial Research and Development*, 257.

[26]Donald J. Quigg, "Safeguarding Intellectual Property — Stimulus to Economic Expansion," in Walker, *Intellectual Property Rights and Capital Formation in the Next Decade*, 40.

[27]Suzanne Scotchmer, "Standing on the Shoulders of Giants: Cumulative Research and the Patent Law," *Journal of Economic Perspectives*, Winter 1991, in Mansfield, *The Economics of Technical Change*, 209.

- allowed for prior use of patented innovations without infringement in certain cases; and

- permited third party participation in patent reexamination proceedings.

S. 507, the Omnibus Patent Act of 1997, as reported to the Senate, was similar except that any inventor who did not choose to obtain a foreign patent could, at the time of filing, request a delay in publication until the patent issued thereby circumventing the 18 month disclosure requirement. This bill also permitted greater participation by third parties in patent reexamination but did not include expanded grounds for reexamination.[28]

In the current Congress, H.R. 1907, the American Inventors Protection Act, was passed by the House on August 4, 1999. The provisions of this bill, sponsors argue, reflect an attempt to address unresolved issues from the previous discussion over patent reform. H.R. 1907 would (among other things):

- establish the Patent and Trademark Office as an independent agency within the Department of Commerce;

- mandate disclosure of information contained in patents 18 months after filing in the United States if the inventor also files for patents abroad;

- guarantee 17 years of patent protection to diligent applicants;

- permit limited prior use of certain patented innovations (business methods) without infringement; and

- accord third party participation in patent reexamination proceedings under specific conditions.

Given what is understood about the role of patents in innovation, the following discussion explores the possible results of suggested changes on the process of technological advancement. Proponents of these legislative initiatives view the proposed alterations as a means to make the patent system more effective. Providing the Patent and Trademark Office with additional authority to determine internal operating procedures and administration under the policy direction of the Department of Commerce would make available the resources to improve the examination process and reduce patent pendency (the time it takes to consider and issue a patent), thereby affording an expanded time frame for enforcement of claims against infringement. However, the change that may significantly alter the relationship between innovation and patents, because of its implications for appropriability and information dissemination, is the requirement for mandatory early publication of patent

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[28]For additional information on related legislation see: Congressional Research Service, *Patent Reform: Overview and Comparison of S. 507 and H.R. 400*, by Dorothy Schrader, CRS Report 97-591, August 4, 1998.

applications 18 months after filing if the inventor also patents abroad.[29] Advocates of early publication claim that this offers a way to facilitate increased creativity and competition by providing background on current technology, avoiding duplication of effort, and highlighting areas of scientific and technological interest to rival firms. Another perceived advantage is that such a change would place U.S. practice in line with foreign patent office procedures that require publication of patents, in the language of the country, within an 18-month time frame. Thus, when American companies file for protection abroad, the relevant information quickly becomes available to foreign competitors in their native language, but it is not accessible in the United States or in English. Domestic firms remain at a distinct disadvantage, particularly small companies that do not have the resources to cull through these applications.

Early publication has been advocated as a means to negate the effects of "submarine" patents. Under previous U.S. patent law, when the term of the patent was determined from the date of grant, certain inventors used dilatory tactics to delay issuance of their own patent (for up to 40 years). During that time, other companies or individuals developed products and processes based on the first firm's concepts. When the "submarine" patent surfaced, the original filer could require expensive licensing arrangements or sue for infringement. The revised system of patent terms from date of filing, coupled with the proposed requirements for information disclosure within 18 months, are seen by some as a way to counteract such maneuvers, place the information in public view, and permit patents to be used for the purposes for which they were intended.

Publication requirements also are viewed by proponents as a mechanism to improve the process of patent awards. It has been argued that early dissemination of information facilitates the submission of prior art at the front end of patent evaluation efforts.[30] According to Michael Kirk, Executive Director of the American Intellectual Property Association, such action will assist the Patent Office in its role of granting patents by making the process easier and more accurate. Potential conflicts can be recognized earlier in the examination activity. In addition, "small entity inventors will be able to receive more complete and accurate patentability assessments and have a much better opportunity to avoid potential infringement issues since potentially adverse patent rights can be more readily identified and monitored."[31]

Opponents of early publication provisions typically are small business owners or individual inventors. They contend that release of information contained in an application prior to the patent award will allow competitors to interfere with the award process. Articulating what many in the community believe, Terry Bibbens of the U.S. Small Business Administration stated in testimony that ". . .large companies

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[29]Under existing law, patent applications are published when the patent is awarded to the inventor.

[30]Prior art indicates that the concept claimed in a patent application is already known (and usually has been published) and therefore cannot be considered novel.

[31]Michael K.Kirk, prepared testimony before the House Committee on Science, Subcommittee on Energy and Environment, May 2, 1996, 9.

would engage in predatory practices and claims against the small company before it has the protection of the patent, and has been able to interest a venture capital investor or other company in joining forces."[32] Contrary to justifications that early publication provides a means to expedite the patent process, opponents contend that large corporations, with the resources to hire lawyers to peruse applications, will use dilatory tactics to oppose the awarding of patents to small companies and will interfere with the system by excessive and unsubstantiated claims of prior art.

Studies have shown that small, high technology companies tend to be particularly innovative. Advocates for these businesses maintain that patent protection is therefore of major importance. Limited resources in smaller firms might make patents more effective because other means of appropriability may be unavailable.[33] Brand name loyalty, consumer feedback, and learning curve advantages are often beyond the reach of small companies. In addition, because such businesses have few sources of internal funding, patents take on added significance when they can be used as collateral to obtain bank or venture capital financing.

It is also argued that attempts to align U.S. patent disclosure with foreign practices will place small firms at a distinct disadvantage. A study commissioned by the Small Business Administration found that while large companies file international patents on about one-half of their inventions, small firms file more than two-thirds of their patents exclusively in the United States.[34] Thus, a significant number of small business patents currently are not subject to foreign publication requirements and therefore are not covered by information disclosure stipulations, but would be if current practices were altered. To address these concerns, H.R. 1907 takes an approach similar to that contained in S. 507 from the 105th Congress and permits a delay in publication until the patent issues if no foreign patent applications are made.

Issues for Consideration

Competitive success often is based on how quickly a firm can bring an innovation to the marketplace. Patents can play a role in the competitiveness of individual companies by stimulating the expenditure of resources necessary to develop an idea into a commercial product or process. The extent to which patents facilitate innovation may be contingent on their ability to encourage this increased investment in research and development. As discussed above, the effectiveness of patents depends primarily on the extent of appropriability conferred and on the additional costs associated with imitation of the invention.

Much of the controversy surrounding proposed changes in current U.S. patent law is related to early publication requirements. The role of information in innovation is critical because technological advancement today is knowledge-based, rather than

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[32]Terry E. Bibbens, prepared testimony before the House Committee on Science, Subcommittee on Energy and Environment, May 2, 1996, 3.

[33]Levin, et. al., *Appropriating the Returns from Industrial Research and Development*, 256.

[34]Bibbens, *Testimony*, 8.

resource-based as in the past. In certain industries, disclosure of information in a patent can provide competitors with valuable insight into company activities. In others, the information is not as critical.[35] The former Commissioner of Patents and Trademarks, Donald Quigg argues that the value of public disclosure of information through patents is underestimated, particularly in areas where the technologies are rapidly advancing. One of the characteristics of scientific research is that knowledge developed in one discipline often serves as the foundation for innovations in another area. As Scotchmer states, "[w]hen new discoveries are kept secret, this crossover factor vanishes and broader social benefit is lost."[36]

Patent protection does not make entry into the market impossible for competitors. Knowledge becomes disseminated rapidly, particularly in an era of international communications.[37] Within certain industries, patents reduce duplication time because of the disclosure of information.[38] Studies by Mansfield and his colleagues found that 60% of patented products had been imitated within four years of their introduction into the marketplace.[39] Information was available to competing firms within one year of product development and, for one-third of 100 firms studied, the data was public within six months. The dissemination of knowledge related to processes occurred less rapidly but usually was accomplished in under 15 months.[40]

Patents increase imitation costs. The greater duplication costs and time associated with patents are vital to their perceived effectiveness.[41] However, there are acknowledged differences among industries. The computer, semiconductor, communications equipment, and aircraft industries are considered innovative, but do not rely extensively on patents to protect their ideas. Trade secrets or rapid introduction of improved technologies are used in place of patents. Thus, it has been argued, effective patent protection is not a necessary factor for technical advancement.[42] The role that patents play in innovation may be particular to the industrial sector under consideration

The debate over patent protection continues. Some experts, such as Donald Quigg, maintain that patents are essential because of their role in information

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[35]Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 209.

[36]Quigg, *Safeguarding Intellectual Property—Stimulus to Economic Expansion*, 41.

[37]Shoven, *Intellectual Property Rights and Economic Growth*, 46-47.

[38]Levin, et. al., *Appropriating the Returns from Industrial Research and Development*, 269-270.

[39]Mansfield, et. al., *Imitation Costs an Patents: An Empirical Study*, 236.

[40]Mansfield, *Intellectual Property Rights, Technological Change, and Economic Growth*, 8.

[41]Levin, et. al., *Appropriating the Returns from Industrial Research and Development*, 269.

[42]Sidney G. Winter, "Knowledge and Competence as Strategic Assets," in Teece, *The Competitive Challenge*, 178.

dissemination.[43] At the same time, others, including Richard Levin and his coauthors, suggest that strong patent protection can impede innovation by slowing down the process in those industries where technological progress is based on earlier discoveries.[44] In exploring any proposed changes to patent law, it might be helpful to consider the proper balance between protection of the inventor and disclosure of information if innovation is the ultimate objective. As noted by Scotchmer, the "...cumulative nature of research poses problems for the optimal design of patent law... The challenge is to reward early innovators fully for the technological foundation they provide to later innovators, but to reward later innovators adequately for the improvements and new products as well."[45]

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[43]Quigg, *Safeguarding Intellectual Property—Stimulus to Economic Expansion*, 44.

[44]Levin, et. al.,*Appropriating the Returns from Industrial Research and Development*, 247.

[45]Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and Patent Law*, 200.