20. Patents

Consider a production chain:

$$A \rightarrow B \rightarrow C$$

Assume that an innovation occurs such that the cost of process B falls. Further assume that there is the possibility of copy-cat inventions that achieve a similar level of cost savings in process B.

There are several different patent regimes that might be put into place.

1. No patent right protection.
2. Patent protection for a period of *t* years; copy-cat patents can be merged.
3. Patent protection for a period of *t* years; copy-cat patents cannot be merged.
4. Patent protection of unlimited duration; copy-cat patents cannot be merged.

The issue of patent rights hinges on the question of efficiency. That is, what is the efficient compensation for innovation.

Knowledge is a public good. As such, it has no marginal cost of production for the marginal consumer. However, this does not mean that the marginal consumer *should* pay zero, or that the optimal license for the patent be zero. Nonetheless, it is true that the question of the efficient price is somewhat arbitrary. Efficiency overall requires that the total payment made for invention equal its marginal cost. Recall Demsetz' example of movies and Coase's examples of lighthouses in the discussion of the optimal supply of a public good.

The problem of applying the public good model to patents, especially using the metaphors of movies and lighthouses, is that we tend to think of patents as unique things. While it seems reasonable to treat movies, which are copyrighted, as identical products, it attacks our sensibilities to do the same for patents. However, in the case of copy-cat patents, there are some intriguing similarities.

We tend to think that because there are multiple ways of saying something, it is not wasteful to have multiple literary works on the same theme. Indeed, we have millions of literary attempts to capture the same idea. On the other hand, many people, either implicitly or explicitly, argue that if one invention does something, then it is wasteful to have others that accomplish the same thing. On closer inspection, this does not seem so clear. Consider a couple of examples:

a) Vending machines—paper clip model v. spiral.
b) Guns.[1]
c) Variable speed windshield wipers.
d) Locomotive steam engines.

In all of these cases, there are/were competing methods of achieving the ultimate consumption product. One or the other seems to have been the best, but there are alternatives.

We cannot be sure that any property rights system will render the efficient level of compensation for these innovations, in the same way that we cannot be sure that the efficient

[1] A quick example of pre-emptive patenting, which McGee calls patent suppression, is the case of John M. Browning, the gun inventor. Quoting McGee: "Browning took out at least 128 patents, almost all of them for repeating sporting and military firearms of various types. Until around 1902, that is, about the twentieth year of his productive career in invention, Browning sold his patents outright (principally to Winchester) for lump sums. At least once Browning sold to one buyer several patents, each of which apparently applied to a firearm design closely competitive with the others. Out of one bundle of, say, four patented designs, only one would be put into serial production. Obviously, these are copy-cat patents.

compensation is received in the private supply of public goods such as movies. All we can do is speculate about the likelihood that one of the four possibilities listed above is better than the others.

Regime 1, which does not allow for property right protection, seems unlikely to be efficient. However, the paper by Bittlingmayer on airframe patent pooling suggests that a substantial part of that industry voluntarily agreed to forego patent protection.[2]

The obvious issue in regimes 2, 3, and 4 involves the question of the length of the patent right.[3] However, the more important issue in my opinion is the treatment of copy-cat innovations. Regime 2 allows the competing inventions to be merged in a way that creates a monopoly. This is the same monopoly that would exist if the innovation is, in fact, unique. In regimes 2 and 3, such a monopoly from uniqueness disappears after *t* years. However, in regime 3, to the extent that there is no uniqueness as evidenced by copy-cat innovations, there is no monopoly. The value of the license is bid down. The license value goes to zero at the expiration of patent life.

A singular characteristic of regime 4 is that the license value only goes to zero when competition so determines. To the extent that there are no alternative production processes, that is, to the extent that an innovation is truly unique and remains so forever, the innovator receives a monopoly price for the invention forever. However, if there are many alternatives, the license value approaches zero in short order. In an important way, in regime 4 competition determines the price that an innovation can command. The more aspects of an innovation that are novel and cannot be duplicated, the higher the return. Competition tests the metal of the innovation.

Which regime is the best? I put my faith in competition. So, I vote for regime 4. Recognize that it is just faith—in the case of innovation and intellectual product just as in the case of public goods, there are many alternative rationing schemes that may yield efficient outcomes.

Some follow-up points: Kitch (1977) argues against an infinite patent life on several bases. One argument is that all inventions will come forth eventually. If inventor A does not do it then inventor B will. Therefore it would be wrong to reward an inventor with an infinite stream of monopoly returns, when he/she just happens to be the first. Maybe, but if the probability that an invention would have come along anyway is correlated with the ease of inventing around it, then the inventor does not get much reward for a trivial invention.

Kitch also argues that our patent system rewards for being first and this encourages premature innovation. This race to patent causes excessive research.

This argument does not appeal to me. Would it make sense to claim that because the copyright system gives claim to literary ideas that there is a race to be the first to make the movie “Saving Private Ryan”? The argument that research is excessive is similarly flawed in my opinion. We don’t argue that investment in movies is excessive when there are two or even two hundred war movies made in a year. (Witness “Saving Private Ryan” and “The Thin Red Line.”) Some are good and some are bad. I think that the same view should hold for inventions. Copy-cat inventions are not wasteful. They are efficient measurement devices. How are we to know whether one invention is important or not unless we can determine its reproduction cost. Research

[2] Geo. Bittlingmayer, *JLE*, April 88, pp 227-248. Notice that the pooling in the airframe industry was different from the pooling in the petroleum industry. McGee discusses patent pooling in his anti-trust section of the paper, which gives details on the petro industry. He mentions Carbon Petroleum Dubbs, C.P. for short, who along with his father Jesse A. Dubbs held patents on "cracking"--oil refining.

[3] There is also the issue of whether there should be different patent lives in different industries.

expenditures that attempt to duplicate a successful invention give us an indication of whether it is truly unusual or merely a commonplace invention. If one invention can be duplicated simply, then the royalties associated with the innovation as well as the expenditures on research are low. If an invention cannot be duplicated, then its royalties remain high, and the expenditures attempting to crack the problem another way are high, too, evidencing the fact that the invention embodies rare insight.

It is fine and good to say ex post that some invention or another was very important, but how can this be determined ex ante. The so-called excessive research expended in the attempt to duplicate a successful patent are the ultimate, only, and ex-post proof.

The idea that patents should be of indefinite duration is a bit extreme. I posed the problem that way to focus the idea on a universal length of patent lives as opposed to the notion of trying to fit different patent lengths to different products. Note that the Constitution does not provide for indefinite patent lives. Article I, section 8 of the Constitution reads “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.”

Also, it is worth reflecting on the fact that the scope of the patent is an issue. If patent rights are defined broadly, then extended lives may yield excessive returns to inventors. There does seem to be much variation in the breadth and scope of the patents that have been issued. In the case of airframes, arguably the patent office gave either the Wrights or Curtiss virtually exclusive control of flight. On the other hand, John Browning’s patents on repeating guns seem to have been trivial in scope as were patents on locomotives. The same kinds of problems must be faced in literature, but usually not on such a grand scale.

A Review of the Literature on Patents

by
Steve Lindsey
with notes by
M.T. Maloney
March 27, 2001

Regardless of national perspective, it is universally true that “patents allow inventors to appropriate the economic benefits flowing from their inventive contributions” (Kaufer). The normative issues surrounding this positive statement are plentiful and worthy of the time devoted to their advancement. I will attempt to simplify these normative issues by assigning them to one of the following two categories: 1) Patents should be regulated more closely, if not eliminated altogether, because patents not only encourage, but endorse socially inefficient monopoly power. 2) A national patent system must be established. Without patents the proper incentive structure for innovation is absent. Primarily because the alternative to a patent system is a system of secrecy, a system that is legally hard to define and protect.

Mainstream patent analysis is neither advocate nor enemy to either issue solely. The stance usually taken is one that recognizes issue 1 as the trade-off to achieve issue 2. While it is true that patents endow monopoly power we must assume that the social disadvantage of monopoly power is overcome by the benefits stemming from the property rights created through the patenting process. Otherwise a welfare maximizing society would not allow a patent system to exist. Consider the inventor who gives us a new product and new consumer satisfaction, such benefits will accrue to society despite the 17 years during which the inventor earns monopoly returns. For this reason we cannot declare a patent system, collectively to be inefficient. Conversely evidence prohibits us from declaring the patent system, collectively to be efficient. But we may, as McGee (1966) suggests, defend the patent system. He writes, “the patent system is . . . easier to defend than many other anti-competitive policies.” However, the existence of a patent system does not guarantee that the status quo is the socially optimal patent system. Consider the trade-off between inefficient monopoly power and proper innovative incentives that is inherent in all patent systems. The fact that such a trade-off exists implies that a socially optimal patent life is attainable (DeBrock, 1985). Who can say that a statutory patent life of 17 years is optimal for the U.S. while other patent systems, world wide have statutory lives of different lengths? The literature reveals that the task of calculating optimal patent life is nontrivial. In general an optimal patent life is not achieved when applied uniformly across all patents. Scherer (1972) endorses patent systems that assign patent life according to individual patent characteristics. He would have the patent system tailor the life of each patent to the economic characteristics of its underlying invention. Kamien and Schwartz (1976), although not opposed to individual consideration, show that invention size will vary directly with length of patent life. Therefore, assuming size to be indicative of quality, longer patent lives will induce larger and better inventions.

If longer is better then one could argue for an infinite patent life, for as Kitch (1977) writes, “why shouldn’t [the patentee] be awarded all of the present value of his invention?” The answer, also put forth by Kitch, is that the invention itself would probably have been invented had someone else not done it, therefore a patent system should not reward for the whole value of the invention. The current system rewards for being first in the innovation race. This type of reward implies a finite patent life.

Even if we assume that the statutory patent life, for whichever patent system, is optimal it does not eliminate all inefficiencies. The presence of these inefficiencies may lead some to question the sentiment I expressed earlier about the longevity of the patent system being the result of benefits exceeding costs. A few examples follow. In 1934 Plant argued that the success and value of the patent system depends on the nature of the inventive activity. If invention rises mainly from the human “’instinct of contrivance,’” or is primarily spontaneous then the “patent system is . . .uncertain [and] . . . the actual provisions of the patent legislation cannot but be arbitrary.” In terms of international inefficiencies Penrose (1973) argues that the operation of a patent system may restrict technology flow rather than enhance it; many international corporations will not do business in a country without first having a patent in the country. Therefore the door to technology is opened, but it does not guarantee the flow of technology. Another inefficiency comes from the incentive to duplicate innovator cost. The monopoly returns that are facilitated by the patent, encourage would be competitors to duplicate innovation efforts in order to capture part of the monopoly returns.

According to Beck (1976) patents are either complements or substitutes to earlier innovation. Complementary patents lower production costs when used in tandem with the primal patent, while substitute patents do not. From a social perspective substitute patents lead to a lower welfare function, which Beck argues is the result of substitute patents generating inefficient duplication cost. McGee (1966), however, argues the suppression of substitute patents, or in his words competing patents, is socially undesirable because it prohibits the entry of patented innovations, which in the hands of another individual may prove quite valuable. Regarding this later point McGee notes that proposing a policy that prohibits the bundling of all patents is not a solution to the problem because such a policy would impede the bundling of complementary patents by a single authority. Complementary patents create economies of scale that benefit both the consumer and producer.[4]

Firms will spend a great deal of money to imitate inventions without violating patent laws. Not only does the value of the patent encourage duplication, but also the fact that imitation cost is much lower than innovation cost. Mansfield, Schwartz, and Wagner (1981) estimate the average cost of imitation to be 35 percent less than the cost of innovation. Consequently, if duplication costs vary directly with patent value the more valuable the patent the greater will be the cost to society.[5]

One potential remedy for inefficient duplication costs and patent endowed monopoly power is to institutionalize compulsory licensing. Compulsory licensing would require that the innovator make his invention available to competitors in exchange for a reasonable royalty rate. Shapiro (1985) notes that compulsory licensing would promote trade among competitors as well as facilitate the diffusion of technological progress within an industry. However, this outcome may result naturally, thus making compulsory licensing a law of nonsense. According to McGee (1966) the only time a patentee will not license his patented invention is when the economies of scale are best achieved through a single manufacturer, or the cost of policing licensees is so great that it outweighs the efficiency loss of having only one producer. The issue of licensing can be resolved empirically. If compulsory licensing is truly unnecessary then empirical observation should confirm that fact: A high rate of patent licensing, absent of any licensing laws, should be sufficient evidence to prove compulsory licensing unnecessary.

Those who consider compulsory licensing to be a valid policy recognize a potential flaw within such a prescription—it creates innovative disincentives. If such is true, compulsory licensing may complicate an otherwise simple patent system by necessitating another optimum. In addition to the optimal patent life, patent authorities must choose an optimal "trade-off position between the negative incentive effects of licensing with the positive consumer price effects" (Tandon, 1982). See also Scherer (1972).

It is also possible for a policy of compulsory licensing to generate greater inefficiencies than it eliminates, not only in the trade-off just mentioned but also in terms of cartel creation. Under a system of licensing it becomes much easier for a firm to license an otherwise valueless patent to competing firms in order to disguise cartel agreements. But these agreements need not go undetected. The price of a competitive product, under legitimate licensing will never fall below the royalty amount, whereas this is not true for a cartel—price may fall well below the royalty amount (Priest, 1977).

A vivid example of duplication costs, negative incentives to innovate, and our government's attempt to decrease the impact of both comes from regulatory changes in the

[4] This is not really such a problem. Antitrust authorities work on this issue all the time in deciding when mergers are horizontal or vertical.

A really important empirical study would be to estimate the welfare loss of patent pooling.

[5] Maybe on one margin, but duplication potentially reduces the licensing cost of the innovation, thus lowering the price of the final product.

pharmaceutical industry. See Kitch ("The Patent System and the New Drug Application), and Grabowski and Vernon (1986). In 1962 the Federal Food and Drug Act underwent a significant legislative change. The amendment impacted three areas mostly: 1) A new drug or device could not be marketed until approved by the Food and Drug Administration (FDA). 2) New drugs or devices must not only be safe, but also effective for the purpose for which it is sold. 3) The FDA must grant permission before human clinical testing can be undertaken.

Before the 1962 Amendment the FDA could restrict a new drug from entering the market only if it held a hearing and acted within 180 days of application submission. It goes without saying that the legislative change imposed real costs on the drug industry. One cost in particular was a shortened patent life. Before the Amendment it was feasible for a drug company to receive 20 years of patent protection—17 years for statutory life and 3 additional years during the patent pending stage. Following the Amendment the effective life of the patent was decreased to nearly 14. Pre-market approval requirements greatly limited the patent rewards to pharmaceutical innovation. Hence an apparent disincentive to produce pharmaceutical innovation. On September 24, 1984 President Reagan signed into law the Drug Price Competition and Patent Term Restoration Act of 1984. This law did two things: 1) It restored part of the patent life lost to pre-market regulatory testing, and 2) Essentially eliminated duplication costs faced by drug imitators. Under this act it became possible for patents to receive a five-year extension. Thereby restoring lost value to pharmaceutical patents. It also allowed drug imitators to submit what is called an Abbreviated New Drug Application (ANDA) in substitute for duplicating all pre-market tests required of the drug innovator.

Following the 1962 Amendment, drug imitators were required to duplicate the same costly tests that the drug innovators conducted. The nature of the costs included millions of dollars as well as at least two years of clinical testing. Compare this procedure to the ANDA, which only requires the drug imitator to demonstrate that his drug is bioequivalent to the innovator's product before being marketed.

It is an interesting exercise to conjecture the effect that the 1962 FDA Amendment and the 1984 Act had on the value of pharmaceutical patents. This is a topic to which I will return and discuss more fully because it closely parallels the content of my paper.

In the meantime I will return to potential adverse firm behavior that stems from patent protection. Gilbert and Newberry (1984) use a model to illustrate the conditions under which a firm may engage in R&D, but absent the intent of technological advancement. A monopolist has an incentive to engage in R&D as a way of maintaining its monopoly power. It can do this by establishing a portfolio of patents that will pre-empt potential competitors from entering the market. Pre-emptive patenting is costly to society in that it requires resources to be spent in new technology, yet once acquired, the new technology is purposely withheld from society. Although adverse behavior such as pre-emptive patenting may be rare in practice it is nonetheless important that the topic, at least, be entertained. The rewards of doing so may not directly impact the development of a particular patent system, but will impact the way one treats academic studies that use patents to measure innovative output. For example, Shapiro (1985) writes that the "single most important factor in determining the rate of technological progress in a given industry is the level of industry-wide expenditures on R&D." One may think that an indirect way to measure technological progress is by measuring the patent activity in a particular industry, or broader in a particular economy. The logical assumption is that there is a one for one correlation between R&D expenditures and patent activity. Therefore when R&D expenditures rise so will the number of patents, thus resulting in increased technological progress. Such reasoning may lead one to overestimate technological progress given the potential behavior of firms to engage in pre-emptive patenting. The idiosyncrasies of patent systems like pre-emptive patenting train us to be aware of the limitations that patent studies purport to measure. It is these measurements and accompanying limitations that I now turn.

Patents have been used as a tool for measuring innovative activity. The nature of this measure has been to count the number of patents applied for or granted for a given time period. These measurements, when taken across time, provide a time series of innovative activity. Hall, Griliches and Hausman (1984) and (1986) infer that patent applications "in any given year [can be used] as an indicator of the value of the additions to the underlying stock of knowledge . . . ." They find a very strong contemporaneous relationship between R&D expenditures and patenting. This relationship also reveals that firms are getting fewer patents from their more recent R&D expenditure, which the authors conclude implies a decline in the effectiveness of R&D expenditures. Most patent count studies are not as elaborate as the one just mentioned. In general, patent counts have been attractive measures of innovation because of their convenience in providing data, but this convenience does not offer protection against certain informational flaws. For example, patent counts assume the average invention and average value are constant. That is, average value today is the same as average value years ago. (Pakes and Schankerman (1986) as well as Pakes and Simpson (1989) suggest that patent values vary across time and across groups of patentees.) Adhering to a constant average value philosophy will lead one to conclude that innovative activity has declined over time, even though other national measurements of productivity have risen. One illustration of this is provided by Gilfillan (1959) who, when comparing economic conditions of 1880 to 1955 writes, "[o]ne would expect American per capita patenting to have risen ten-fold; instead it has declined to 79 per cent of the 1880 per capita figure . . . ." The fact, that the rate of patenting, has declined is not disputed by economists, however the forces driving that result are subject to debate. A number of economists suggest this phenomenon to be the by-product of a patent propensity that is less than one. Which simply means some innovators choose not to patent their invention. See Gilfillan (1959), Horstmann, MacDonald and Slivinski (1985), Pakes and Simpson (1989). Griliches (1989) suggests that patent declines may be a factor of the patent office itself. Implying that the number of patents granted is a function of the resources available to the patent office including the number of available patent examiners. Additional explanations for the decline in patenting are provided by Gilfillan, however his explanations lack empirical legitimacy and thus are not treated seriously. They include: a) patenting becomes less attractive as the number of patents struck down by the courts increases, b) the increasing size of corporations decreases their propensity to patent, and c) there are more pure scientists today. On this last point he argues pure scientists and physicians often refuse to take out patents.

Universal trends in patenting activity have lead scholars to look for the factors driving them. An explanation that J. Schmookler fathered is demand, induced innovation. During the period of 1790-1846 innovative activity increased sharply. Proponents of the demand side theory believe that the sharp rise in inventive activity was the result of an increase in demand for produced goods, and that this demand was important in "influencing both the level and direction of inventive activity" (Sokoloff, 1988). As demand for goods increased the perceived return to invention also rose, thus inducing more invention. Opponents to the demand theory argue that shifts in demand cannot fully explain historical increases in inventive activity. They argue that the existing stock of knowledge was not large enough to satisfy any sizable increase in demand. See Sokoloff (1988).

Although I have not expressly discussed the topic I have already implied that patents have economic value. The value of patents can be very large, but as most studies show the average value of a patent is small, resulting in a very skewed distribution of patent values. For example the median value of a French patent in 1970 was $847 while the mean value was $6656 (Schankerman and Pakes, 1986). See also Pakes (1986), Pakes and Simpson (1989), and Sullivan (1994). Measuring patent values is very challenging because so very few patents are traded in market-type conditions. Nevertheless efforts have been made, if not to measure value, at least to know in which direction the value of patents go when subject to changes in legislative or market conditions. The reason for advancing patent issues towards estimating their value is that such measures facilitate better evaluations of patent systems. There are many similarities among patent systems worldwide, but there are also sufficient differences that a comparative study on patent values helps to identify an optimal patent system. See Pakes and Simpson (1989) and Sullivan (1994). However, the success and accuracy of these measurements are highly dependent upon the patent system in operation. For example, the methodology recently employed by Schankerman and Pakes (1986) and Sullivan (1994) could not be applied to the U.S. patent system until recently because the institutional structure of our system prohibited the collection of information that makes their estimates possible.

Recall the invitation I made earlier to conjecture the effect the 1962 FDA Amendment and the Drug Price Competition and Patent Term Restoration Act of 1984 had on the value of pharmaceutical patents. Assuming the average drug, in both quality and effectiveness, remains constant between the years 1962 and 1982, it seems intuitive that pharmaceutical patent values would be much lower during this period than pharmaceutical patent values prior and post this period. This change, I will presume was motivated by the change in effective patent life. Following the 1962 Amendment the effective patent life was reduced by nearly one third, but was subsequently restored with the passage of the 1984 Act. Since the literature does not estimate the value of pharmaceutical patents during this period we can only rely upon our theoretical leanings, but the literature to which I now turn establishes ways in which such a measurement could be calculated.

A review of the literature reveals three methods for valuing patents: 1) patent count, 2) patent renewal, and 3) patent event-study. The patent count, as mentioned previously, has been employed as an index or gauge of innovative activity, rather than a means to explicitly measure patent value. I list it as a patent valuing method because indirect measures of patent value seem to be implied by those who have employed this method. Schmookler (1954) for instance, concluded from his patent count study: “the purpose of invention may be construed as the reduction in the amount of inputs required to achieve a given result.” The reduction in the amount of inputs used, when discounted, reveals the economic value of the invention. While the return, a patent holder is able to extract from his patent, defines the patent value (Sullivan, 1994). Therefore the more resources a given invention saves the more valuable becomes the patent.

The ability of patent counts to convey information about patent value is greatly limited. Pakes (1986) is suspect of patent count studies because the relationship between patent value and current and past patents is very unstable. This instability may be a consequence of inventors applying for patents when little knowledge about the success of the patent is known. See Pakes (1986), Sullivan (1994), and Kitch (1977). For example, consider the U.S. patent system, which does not require an invention to be commercially developed before receiving a patent. It will award a patent for any invention that works. In cases where innovation between different individuals is identical the U.S. patent system will award the patent to the first inventor, not the first to file. Therefore, it is possible for the senior applicant to be dislodged from his patent if a competing applicant files within one year of the senior applicant and is determined to be the first inventor. Such a system, as Kitch explains, induces early introduction of inventions because the patent system, itself rewards for being first.

Although little merit is given to the patent count as a value-measuring device it may prove highly valuable when used as a companion to other value procedures. Schankerman and Pakes (1986) suggest using a patent count to augment their index of average patent values.

Mansfield (1986) concludes from his study that patents are a valuable resource because apparent “benefits of patent protection . . . are judged to exceed its costs.” Mansfield’s conclusion is not unique, but nonetheless appropriate to use as the introduction to the next patent value methodology—patent renewal. The patent renewal methodology assumes agents are rational beings that will discontinue patent protection whenever the costs of such protection exceed the benefits. The key, therefore, to valuing patents using this method is to observe agent behavior in light of these costs. The only patent system that facilitates this type of observation is one that requires a renewal fee. Renewal fees are annual fees that the patent holder is charged in order to preserve patent protection for the subsequent period. If the renewal fee is not paid in any single year, the patent is permanently cancelled. Such a requirement was non-existent in the U.S. prior to 1982. Therefore, patent value studies that employ renewal methods will generally use data from outside the U.S., namely Europe.

The theory behind the models which employ this method is as follows: the patent holder who pays the renewal fee obtains both the current returns that accrue to the patent over the coming period and the option to pay the renewal fee and maintain the patent for the subsequent period. Agents, acting optimally will pay the renewal fee only if the sum of current returns plus the value of the option exceeds the renewal fee. When an agent allows his patent to expire we don’t know what the perceived patent value is except that it is less than the current period’s renewal fee and greater than last period’s. Such information has proved very useful in aggregate patent value studies. See Pakes and Simpson (1989), Schankerman and Pakes (1986), and Sullivan (1994). These models derive parameters that predict the actual proportions of patents that drop out each period. Schankerman and Pakes allow the agent to choose the optimal patent life span, which is the span that maximizes the expected discounted value of the net return. Sullivan follows a similar model, but enhances the accuracy of his model by postponing value measurements until the third year of patent life. Postponing such measurements avoids the period of uncertainty wherein the inventor is not certain about the true value of his invention.

Sullivan’s (1994) paper when used as a tool of comparison facilitates valuable insight into Schankerman and Pakes’ (1986) paper. Schankerman and Pakes estimate patent values for three European countries in the post 1950 period, while Sullivan estimates patent values for similar European countries one century earlier. The economic conditions between these two time periods are so different that any variation in value estimates can be attributed to this difference. Sullivan found the real cost of patents in the period 1852-1876 to be much higher than the real cost of patents a century later. Sullivan estimates that patent fees for the earlier period were 18.5 times more expensive than the later period. Based on this information, one may presume that patentees in the earlier period had a more accurate idea of their patent’s value than their comparison group a century later. This wisdom came by way of the very high patent costs. The high cost of patenting in the earlier period encouraged more experimentation and development prior to patent application than occurred in the later period. This effect is manifest in a comparison of the renewal rates between the two periods and the trend in the mean value of patents. For patents that survived beyond eight years only 10.4 percent were renewed in the earlier period while in the later period the average percent of patents renewed was 60. In real terms the mean value of patent rights declined by 15 percent over the century of time.

A question of great relevance, as well as an issue in many patent value studies is the question of what exactly is being measured. The issue namely is patent value versus the economic value of the innovation the patent protects. Pakes and Simpson, Sullivan, and Austin purport to measure patent value and fault earlier studies that claim to measure patent value when in fact measure the innovation's value. The similarities between these two measurements may not be as close as they are perceived to be. The value of patent protection in determining innovation value varies according to patent and patentee. Pakes and Simpson claim the "estimates of the distribution of the value of patented ideas may not contain much information on the value of patent protection." This is consistent with earlier studies that show the value of patent protection to vary greatly among industries. See Mansfield, Schwartz, and Wagner (1981), and Mansfield (1984).

The last value method is the event-study method. Austin (1993) applied this method to the U.S. patent system. The characteristic that makes the event-study preferred to renewal studies is its ability to address patent values at a disaggregate level. Pakes (1986) writes "[i]ssues related to which sectors of a particular economy, and which economies, derive disproportionate benefits from patent laws lie at the heart of most discussions of the costs and benefits of alternative patent systems." No other value estimating method is better able to measure disproportionate benefits than the event-study. For evidence of this I must refer to Austin. Austin estimated patent values within the biotechnology industry. Although his study is not an attempt to measure disproportionate benefits it does lay the foundation for future studies that will. How this can be done is by measuring patent values unique to other industries, thereby creating comparison data wherein an objective analysis of disproportionate benefits can be made. Since the contents of this paper closely parallel the methods employed by Austin I will reserve a discussion of his method until later. But let it be known that the event-study method to measuring patent values is an extension of Schwert's (1981) work on measuring the firm and industry effects of regulation.

References Reviewed

Austin, David H. "An Event-Study Approach to Measuring Innovation Output: The Case of Biotechnology," *American Economic Review*, vol. 83, May 1993, pp. 253-258.

Beck, R.L., "Patents, Property Rights, and Social Welfare: Search for a Restricted Optimum," *Southern Economic Journal*, 43 (1976), 1045-1055. HC107.A13 S7

Beck, R.L., "Patents and Over-Investment in Process Inventions: Reply," *Southern Economic Journal*, 45 (1978), 289-292.

Beck, R.L., "Competition for Patent Monopolies," in *Research in Law and Economics*, ed. by R.O. Zerbe, 3 (1981), 91-100.

Beck, R.L., “The Prospect Theory of the Patent System and Unproductive Competition,” *Research in Law and Economics*, 5 (1983), 193-209.

Beck, R.L., “Does Competitive Dissipation Require A Short Patent Life?”, *Research in Law and Economics*, 8 (1987), 121-129.

Cave, J. A. K., “A Further Comment on Preemptive Patenting and the Persistence of Monopoly,” *American Economic Review*, 75 (1985), 256-258.

DeBrock, L. M., “Market Structure, Innovation, and Optimal Patent Life,” *Journal of Law and Economics*, 28 (1985), 223-244.

Gilbert, R. J., and D. M. G. Newberry, “Preemptive Patenting and the Persistence of Monopoly,” *American Economic Review*, 72 (1982), 514-526.

Gilbert, R. J., and D. M. G. Newberry, “Preemptive Patenting and the Persistence of Monopoly: Reply,” *American Economic Review*, 74 (1984), 251-253.

Gilfillan, S. C., “An Attempt to Measure the Rise of American Inventing and the Decline of Patenting,” *Technology and Culture*, 1 (1959), 201-214.

Grabowski, H. G. and J. Vernon, “Longer Patents for Lower Imitation Barriers: The 1984 Drug Act,” *American Economic Review*, 76 (May 1986, *Papers and Proceedings*, 1985), 195-198.

Griliches, Z., “Patents: Recent Trends and Puzzles,” *Brookings Papers on Economic Activity, Microeconomics 1989*.

Hall, B. H., Z. Griliches, and J. A. Hausman, “Patents and R&D: Is There a Lag?” *International Economic Review*, 27 (June 1986), 265-283.

Hausman, J. A., B. H. Hall, and Z. Griliches, “Econometric Models for Count Data and with an Application to the Patents-R&D Relationship,” *Econometrica*, 52 (July 1984), 909-938.

Kamien, M. I., and N. L. Schwartz, “Patent Life and R&D Rivalry,” *American Economic Review*, 64 (1974), 183-187.

Kaufer, Erich. *The Economics of the Patent System*, 1989, Harwood Academic Publishers, GmbH.

Kitch, E. W., “The Nature and Function of the Patent System,” *Journal of Law and Economics*, 20 (1977), 265-290.

Kitch, E. W., “Patents, Prospects, and Economic Surplus: A Reply,” *Journal of Law and Economics*, 23 (1980), 205-207.

Kitch, E., ‘The patent system and new drug application.’ In *Regulating New Drugs*, (ed. R. Landau), 81-108. Chicago: University of Chicago. KF3885.A75 R43

Kunik, I. J., “A Patent Attorney Takes Issue,” *Technology and Culture*, 1 (1959), 214-220.

Landau, D. L., “Patents and Over-Investment in Process Inventions? Comment,” *Southern Economic Journal*, 45 (1978), 285-288.

MacDonald, G. M. and A. Slivinski, “Patents as Information Transfer Mechanisms: To Patent or (Maybe) Not to Patent,” *Journal of Political Economy*, 93 (October 1985), 837-858.

McFetridge, D. G., and D. A. Smith, “Patents, Prospects, and Economic Surplus: A Comment,” *Journal of Law and Economics*, 23 (1980), 197-203.

McGee, John S. "Patent Exploitation: Some Economic and Legal Problems," *Journal of Law and Economics*, 1996, pp. 135-62.

Maclaurin, W. R., "Patents and Technical Progress: A Study of Television," *Journal of Political Economy*, 58 (1950), 142-157.

Mansfield, E., "R&D and Innovation: Some Empirical Findings," in Griliches, ed., *R&D, Patents, and Productivity*, 127-148.

Mansfield, E. "Patents and Innovation: An Empirical Study," *Management Science*. Vol. 32, No.2, Feb. 1986, pp.173-81.

Mansfield, E., M. Schwartz, S. Wagner. "Imitation Costs and Patents: An Empirical Study," *The Economic Journal*. Vol. 91, Dec. 1981, pp.901-18.

Markham, J. W., "The Joint Effect of Antitrust and Patent Laws upon Innovation," *American Economic Review*, Papers and Proceedings, 56 (1966), 291-300.

Pakes, A. and M. Simpson, "Patent Renewal Data," *Brookings Paper on Economic Activity—Microeconomics 1989*.

Pakes, A., "Patents as Options: Some Estimates of the Value of Holding European Patent Stocks," *Econometrica*, 54 (1986), 755-784.

Penrose, E., "International Patenting and the Less-Developed Countries," *Economic Journal*, 83 (1973), 768-786.

Plant, A., "The Economic Theory Concerning Patents for Inventions," *Economica*, New Series, 1 (1934), 30-51.

Priest, G. L., "Cartels and Patent License Agreements," *Journal of Law and Economics*, 20 (1977), 309-378.

Scherer, F. M., "Firm Size, Market Structure, Opportunity, and the Output of Patented Inventions," *American Economic Review*, 55 (1965), 1097-1125.

Scherer, F. M., "Nordhaus' Theory of Optimal Patent Life: A Geometric Reinterpretation," *American Economic Review*, 62 (1972), 422-427.

Schankerman, M. and A. Pakes, "Estimates of the Value of Patent Rights in European Countries During the Post-1950 Period," *The Economic Journal*, December 1986, pp. 1052-76.

Schmookler, J., "An Economist Takes Issue," *Technology and Culture*, 1 (1959), 214-220.

Schwert, W. G., "Using Financial Data to Measure Effects of Regulation," *The Journal of Law and Economics*, April 1981, pp. 121-59.

Shapiro, C., "Patent Licensing and R&D Rivalry," *American Economic Review*, Papers and Proceedings, 75 (1985), 25-30.

Sokoloff, K., "Inventive Activity in Early Industrial America: Evidence from Patent Records, 1790-1846," *Journal of Economic History*, 28 (1988), 813-850.

Sullivan, R. J., "Estimates of the Value of Patent Rights in Great Britain and Ireland, 1852-1876," *Economica*, February 1994, pp. 37-58.

Tandon, P., "Optimal Patents with Compulsory Licensing," *Journal of Political Economy*, 90 (1982), 470-486.

Wright, B. D., "The Economics of Invention Incentives: Patents, Prizes, and Research Contracts," *American Economic Review*, 73 (1983), 691-707.