Vanderbilt Law Review

Volume 56
Issue 1 *Issue 1 - January 2003*

Article 3

1-2003

Perfecting Patent Prizes

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When anthrax attacks recently led to a run on the patented antibiotic drug Cipro,[1] politicians and commentators suggested that the government consider purchasing generic alternatives.[2] Some used the occasion to illustrate what they perceived as a broader problem with patent protection: that pharmaceutical companies seeking profits would not allow the sick to obtain access to needed medications.[3] The argument repeated a familiar refrain in the intellectual property debate, as a long history of articles has inquired whether society would be better off with no patent[4] or copyright law[5] at all. Even

1. *See* Tamar Lewin, *Anthrax Scare Prompts Run on an Antibiotic*, N.Y. TIMES, Sept. 27, 2001, at B8.

2. *See, e.g.*, Shankar Vedantam, *Cipro Is Not the Only Pill That Fights Anthrax*, WASH. POST, Oct. 17, 2001, at A20 (reporting that Senator Charles E. Schumer "issued a public appeal that the government suspend Bayer's patents and allow generic companies to add to the supply"); *see also* Donald G. McNeil, Jr., *A Rush for Cipro, and the Global Ripples*, N.Y. TIMES, Oct. 17, 2001, at A1 (discussing such proposals); Jesse Pesta & Daniel Pearl, *Indian Drug Makers May Now Imitate Cipro: Controversial for Knockoffs of AIDS Pills, the Firms May Do Same for Anthrax*, WALL ST. J., Oct. 19, 2001, at A13 (same). President Bush rejected these proposals on the ground that patent law made them illegal. *See* Elisabeth Bumiller, *Administration Won't Allow Generic Versions of Drug*, N.Y. TIMES, Oct. 18, 2001, at B8. The Canadian government initially embraced similar proposals. *See* Amy Harmon & Robert Pear, *Canada Overrides Patent for Cipro to Treat Anthrax*, N.Y. TIMES, Oct. 19, 2001, at A1. Subsequently, however, the Canadian government backed down, agreeing to rely on Bayer unless the company was unable to accommodate requests for the drug. *See* Tom Cohen, *Canada Allows Bayer to Supply Anthrax*, ASSOCIATED PRESS, Oct. 23, 2001, *available at* 2001 WL 29336130.

3. *See, e.g.*, Ronald Johnson, *In the War of Nerves, the Capitol Is a Front*, N.Y. TIMES, Oct. 19, 2001, at A18 (arguing in a letter to the editor that developing countries should be allowed to import generic versions of AIDS drugs); Anthony York, *Is It Time to Bust the Cipro Patent?*, *at* http://www.salon.com/tech/feature/2001/10/18/cipro_patent/index.html (last visited Oct. 15, 2002) (reporting Senator Charles Schumer's call for governmental purchase of generic Cipro, as part of a broader website critiquing expansive patent protection). The accusation arguably is misplaced in the case of Cipro, because the drug was not priced so high that any American whose life was in danger would not be able to obtain it.

4. *See, e.g.*, FRITZ MACHLUP, AN ECONOMIC REVIEW OF THE PATENT SYSTEM, SUBCOMMITTEE ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE SENATE COMMITTEE ON THE JUDICIARY, 85TH CONG., 44-45 (Comm. Print 1958) (summarizing arguments both for and against the patent system); EDITH PENROSE, THE ECONOMICS OF THE INTERNATIONAL PATENT

recently, commentators have questioned the broad scope of intellectual property protection, arguing that business methods should not be patentable[6] or that copyright terms should be shorter than Congress has dictated.[7] The antiprotection advocates have won some

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SYSTEM (1951) (arguing that the patent system harms developing countries); C. TAYLOR & Z. SILBERSTON, THE ECONOMIC IMPACT OF THE PATENT SYSTEM 194-208 (1973) (reporting results of a survey suggesting that abolition of the patent system would affect innovation in some industries more than in others); Brian Peckham, *Should the U.S. Patent Laws Be Abolished?*, 11 J. CONTEMP. L. 389, 421 (1985) (concluding that present knowledge does not strongly justify immediate abolishment of the patent system); Donald F. Turner, *The Patent System and Competitive Policy*, 44 N.Y.U. L. REV. 450, 454-55 (1969) (identifying various costs of the patent system); *The Debate on the Patent Laws*, 27 ECONOMIST 656, 656 (1869) (predicting that it was "probable enough that the Patent Laws will be abolished ere long," as the laws "either are, or are becoming, out of date"). Some recent researchers have argued that patent protection may not be necessary in some industries even if it is necessary in others. *See* JAMES BESSEN & ERIC MASKIN, SEQUENTIAL INNOVATION, PATENTS, AND IMITATION (Mass. Inst. of Tech. Working Paper No. 11/99, 1999). For discussions of nineteenth-century debates on patent law, see H.I. DUTTON, THE PATENT SYSTEM AND INVENTIVE ACTIVITY DURING THE INDUSTRIAL REVOLUTION, 1750-1852 at 17-29 (1984); and Fritz Machlup & Edith Penrose, *The Patent Controversy in the Nineteenth Century*, 10 J. ECON. HIST. 1 (1950). For an interesting compendium of quotations denouncing the patent system, see Gordon Irlam, *Re: Articles, Books Against Copyright, Trademark, Patent*, COALITION FOR NETWORKED INFORMATION, *at* http://www.cni.org/Hforums/cni-copyright/1994-04/0648.html (last visited Oct. 10, 2002).

5. *See, e.g.*, FRANCIS HARGRAVE, AN ARGUMENT IN DEFENSE OF LITERARY PROPERTY 30-33 (Garland Publishing, Inc. 1974) (1774); T. MACAULAY, SPEECHES ON COPYRIGHT 21-24 (C. Gaston ed., 1914); ADAM SMITH, LECTURES ON JURISPRUDENCE 83 (R.L. Meek et al. eds., Oxford Univ. Press 1978) (1896); Robert M. Hurt & Robert M. Schuchman, *The Economic Rationale of Copyright*, 56 AM. ECON. REV. 421 (1966); William M. Landes & Richard A. Posner, *An Economic Analysis of Copyright Law*, 18 J. LEGAL STUD. 325, 328-29 (1989); Arnold Plant, *The Eeonomic Aspects of Copyright in Books*, 1 ECONOMICA 167 (1934). Perhaps the most famous exchange on the utility of copyright law is between then-Professor Stephen Breyer and Professor Barry Tyerman, with Tyerman more enthusiastic about copyright than Breyer. *See* Stephen Breyer, *Copyright: A Rejoinder*, 20 UCLA L. REV. 75 (1972); Stephen Breyer, *The Uneasy Case for Copyright: A Study of Copyright in Books, Photocopies, and Computer Programs*, 84 HARV. L. REV. 281 (1970); Barry W. Tyerman, *The Economic Rationale for Copyright Protection for Published Books: A Reply to Professor Breyer*, 18 UCLA L. REV. 1100 (1971).

6. The Federal Circuit found business methods to constitute patentable subject matter in *State St. Bank & Trust Co. v. Signature Fin. Group, Inc.*, 149 F.3d 1368 (Fed. Cir. 1998). Critics include Rochelle Cooper Dreyfuss, *Are Business Method Patents Bad for Business?*, 16 SANTA CLARA COMPUTER & HIGH TECH. L.J. 263, 277-80 (2000); Leo J. Raskind, *The* State Street Bank *Decision: The Bad Business of Unlimited Patent Protection for Methods of Doing Business*, 10 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 61 (1999); Brian P. Biddinger, Note, *Limiting the Business Method Patent: A Comparison and Proposed Alignment of European, Japanese and United States Patent Law*, 69 FORDHAM L. REV. 2523 (2001); James Gleick, *Patently Absurd*, N.Y. TIMES MAGAZINE, March 12, 2000, § 6, at 44; *see also* Nicholas Groombridge & Christopher Loh, *Congress Takes Aim at Business Method Patents*, N.Y. L.J., Mar. 6, 2001, at 1. Defenders of business method patents include Jeffrey R. Kuester & Lawrence E. Thompson, *Risks Associated with Restricting Business Method and E-Commerce Patents*, 17 GA. ST. U. L. REV. 657 (2001); and Sari Gabay, Note, *The Patentability of Electronic Commerce Business Systems in the Aftermath of* State Street Bank & Trust Co. v. Signature Financial Group, Inc., 8 J.L. & POL'Y 179 (1999).

7. In 1998, Congress extended the copyright term of many works to seventy years beyond the author's death, twenty years beyond the previous length. *See* Sonny Bono Copyright Term

victories,[8] but the Patent and Trademark Office does business largely as before, or even as never before.[9]

At least some of the Cipro-related proposals, however, offered a new twist. The government, it was argued, should allow generic drug manufacturers to produce the drug ciprofloxacin and charge a low price for it,[10] but Bayer, Cipro's manufacturer and patent owner, should be compensated.[11] Such a proposal may seem particularly appropriate given concerns that Bayer would not by itself be able to produce enough of the drug to meet demand,[12] but the proposal has

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Extension Act, Pub. L. No. 105-298, § 102(b)(1)-(2), 112 Stat. 2827, 2827 (1998) (codified at 17 U.S.C. § 302(a) (2000)). Critics have argued that this period is too long. *See* Edward C. Walterscheid, *The Remarkable—and Irrational—Disparity Between the Patent Term and the Copyright Term*, 83 J. PAT. & TRADEMARK OFF. SOC'Y 233 (2001); *see also* William Patry, *The Failure of the American Copyright System: Protecting the Idle Rich*, 72 NOTRE DAME L. REV. 907, 923-30 (1997) (critiquing the proposed extension); Jenny L. Dixon, Note, *The Copyright Term Extension Act: Is Life Plus Seventy Too Much?*, 18 HASTINGS COMM. & ENT. L.J. 945 (1996) (same); Joseph A. Lavigne, Comment, *For Limited Times? Making Rich Kids Richer via the Copyright Term Extension Act of 1996*, 73 U. DET. MERCY L. REV. 311 (1996) (same). At one time, the copyright and patent terms were the same. *See* Walterscheid, *supra*, at 234.

Lloyd Weinreb has argued that proposals for increasing the scope of copyright protection generally have not considered the costs and benefits of such expansion:

> The inclusion of new subject matter has generally been responsive not to a demonstrated need but to the bare assertion of need, indicated only by the proliferation of copies and occasional anecdotal evidence, and an analogy to books, for whicb copyright was taken for granted. The expansion of copyright in ways that the argument cannot plausibly justify suggests its substantial irrelevance to the outcome, except as a talking point.

Lloyd L. Weinreb, *Copyright for Functional Expression*, 111 HARV. L. REV. 1149, 1243 (1998).

8. The most prominent victories of antiprotection forces, however, have been technological rather than legal. *See, e.g.*, Lior Jacob Strahilevitz, Napster, Gnutella, Hybrids, and the (Re)emergence of Anti-Property 6-16 (Aug. 29, 2001) (unpublished manuscript, on file with author) (exploring the continuing success of copyright infringement through peer-to-peer file sharing despite the Ninth Circuit's injunction preventing such infringement on Napster).

9. The number of patent applications rose from 164,558 in 1990 to 270,187 in 1999, with grants rising from 90,365 to 153,485. *See* U.S. PATENT AND TRADEMARK OFFICES, *at* http://www.uspto.gov/web/offices/ac/ido/oeip/taf/-us_stat.pdf (last visited Oct. 10, 2002).

10. Senator Schumer emphasized that the concern was not just adequate production, but also that the drug be sold at "reasonable prices." Robert Pear, *Government Talks with Drug Companies About Buying Antibiotics That Treat Anthrax*, N.Y. TIMES, Oct. 20, 2001, at B8.

11. *See, e.g.*, McNeil, *supra* note 2 (discussing the possibility of a taking of the patent under the eminent domain power); *US Government Could Override Bayer's Cipro Patent* (Minn. Pub. Radio radio broadcast, Oct. 17, 2001), *available at* 2001 WL 24074267 (same). Advocates of the government's overriding the patent cited 28 U.S.C. § 1498 (2000), which provides that when the United States infringes a patent, "the owner's remedy shall be by action against the United States in the United States Court of Federal Claims for the recovery of his reasonable and entire compensation for such use and manufacture."

12. Bayer has insisted that it would be able to meet demand. *See* Keith Bradsher, *Bayer Insists Cipro Supply Is Sufficient; Fights Generic*, N.Y. TIMES, Oct. 21, 2001, § 1B (A Nation Challenged), at 7. If Bayer were not able to meet demand with its own manufacturing facilities, it could seek to contract with generic drug manufacturers to produce the drug for Bayer. *See*

broader resonance. In theory, the government could pay patent owners to place their discoveries in the public domain. Doing so would encourage research and development to produce inventions, while ensuring that the rich and poor alike could benefit from them. Indeed, the newest generation of scholars to challenge the foundations of intellectual property law has not called for simple abolition of intellectual property rights, recognizing the importance of the innovation incentives that these rights provide. Instead, they have considered the alternatives of prize or reward systems, in which the government would provide some form of monetary compensation instead of patent or copyright protection.

The basic idea of a prize system is not new. Michael Polanvyi trumpeted the idea as a means of patent reform back in 1944,[13] and participants in a nineteenth-century debate about the appropriateness of patent protection recognized the possibility that the government might buy out some patents.[14] There are historical precedents for

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Vanessa Fuhrmans, *Questions of Security: Bayer May Ask Rivals to Help Make Cipro*, WALL ST. J., Oct. 18, 2001, at A10.

13. *See* Michael Polanvyi, *Patent Reform*, 11 REV. ECON. STUD. 61 (1944). Polanvyi summarizes his primary proposal as follows: "In order that inventions may he used freely by all, we must relieve inventors of the necessity of earning their rewards commercially and must grant them instead the right to be rewarded from the public purse." *Id.* at 65 (emphasis omitted). Later, he elaborates that the proposal "is to supplement licences of right by government rewards to patentees on a level ample enough to give general satisfaction to inventors and their financial promoters." *Id.* at 67 (emphasis omitted). While Polanvyi suggests that rewards would be hased on information from patent holders and licensees, he does not offer a detailed justification of his assumption that the government would be able to use such information to calculate rewards with sufficient accuracy. Polanvyi, without elaboration, explains simply that prizes should depend "only [on] data endorsable by accountants' certificate." *Id.* at 68. Perhaps recognizing the potential for inaccurate decisionmaking, Polanvyi adds that the system need only be "not markedly less fair than the rewards which are earned by patentees to-day." *Id.*

14. R.A. Macfie summed up such a proposal as follows:

> In every patent there should be a condition that the State, from public moneys, or moneys supplied by individuals, shall be entitled to demand that the value of the invention be estimated, and, on this value being paid (with a liberal percentage added in consideration of "compulsory sale"), the use of the invention should become free to all the Queen's subjects (even in the Colonies, so far as privileges granted there do not clash).

2 R.A. MACFIE, COPYRIGHT AND PATENTS FOR INVENTIONS, at vi (Edinburgh, T. & T. Clark 1883). Macfie also reports comments by various supporters of reward schemes. In 1795, for example, Sir John Sinclair proposed "a general agreement among the powers of Europe, and of the United States of America, for the purpose of rewarding those who make any useful discovery, interesting to the species at large." *Id.* at 33. Others provided more detail on the mechanism for valuing patents, with Sir David Brewster arguing that a "Board at once scientific and practical, containing men of practical sagacity, and scientific men at the same time . . . might in my opinion come to a very sound decision on the value of a patent-right." *Id.* at 33-34 (alteration in original).

awarding prizes for the development of useful information,[15] and even today prizes are used by at least one firm as a way to encourage solutions to scientific problems.[16] Moreover, government-funded research dollars rival those from private research supported by the patent system.[17] The new generation of scholars, however, has offered twists and credibility to the debate.[18] Steven Shavell and Tanguy van Ypersele have described a prize system that inventors could opt into

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Commentators also offered concerns about the proposal—concerns that reflect some of the issues that the more modern literature addresses. R.W. Thomson, the President of the Royal Scottish Society of Arts, recognized the benefits and costs of delaying payment of a reward:

> It would be very easy for a scientific tribunal sitting now to determine the value of inventions which have been in use for a number of years, but the task the commission would have to fulfill would be to judge of the value of an invention before it is developed. . . . If the inventor is simply to *register* his invention and send it out into the world, letting all who wish bring it into use and work what improvements they please upon it, postponing the reward to the inventor until time has been given to ascertain the value of his invention, then the difficulty arises which, to all practical men acquainted with the growth and change which all inventions undergo, is at once evidence, how would it be possible to ascertain how mucb is due to the original inventor, and bow much to those who have added successive improvements, and, in fact, turned what is very often a crude idea into a successful invention?

Id. at 36.

15. A famous example is the offer of a £20,000 prize for a chronometer, a device to determine tbe location of a ship. Amateur clockmaker John Harrison invented tbe device but was initially denied the prize. *See generally* DAVA SOBEL, LONGITUDE (1995) (providing a detailed history); Frederick C. Leiner, *Book Review*, 27 J. MAR. L. & COM. 671 (1996) (reviewing SOBEL, *supra*) (offering a brief summary). The Society of Arts and the British Parliament tried to replicate the success of such approaches by offering prizes, but the experiments were unsuccessful, in part because prizes were too small. *See* DUTTON, *supra* note 4, at 25-26. In the United States, the American Philosophical Society sometimes offered modest prizes, such as a seventy-dollar prize "[f]or the best construction of improvement of ship-pumps." *Notification*, PA. GAZETTE, June 22, 1796, at n.p., *available on* Accessible Arcbives, Penn. Gazette Database, Item No. 81211, http://srch.accessible.com/accessible/text/gaz4/00000812/-00081211.htm (last visited Oct. 10, 2002). Prizes were of greater though still modest impact in France. *See generally* ELISABETH CRAWFORD, THE BEGINNINGS OF THE NOBEL INSTITUTION: THE SCIENCE PRIZES, 1901-1915, at 16-22 (1984) (describing scientific prizes in Europe in the years preceding the establishment of the Nobel Prizes).

16. *See* http://www.innocentive.com; *see also Online Bounties and Scientific Hired Guns: Problem-Solvers Rewarded in Novel Search for Researchers*, CNN, Aug. 25, 2002, *available at* http://www.cnn.com/2002/TECH/science/08/25/scientific.bounties.ap/index.html (discussing the website) (last visited Nov. 23, 2002).

17. About sixty percent of all U.S. research-and-development expenditures are privately funded, with the public sector providing disproportionate resources for basic research. *See* Linda R. Cohen & Roger G. Noll, *Privatizing Public Research*, SCI. AM., Sept. 1994, at 72, 75; John M. Golden, *Biotechnology, Technology Policy, and Patentability: Natural Products and Invention in the American System*, 50 EMORY L.J. 101, 136 (2001). For an economic analysis of why the government might offer grants in addition to intellectual property protection, see Brett Frischmann, *Innovation and Institutions: Rethinking the Economics of U.S. Science and Technology Policy*, 24 VT. L. REV. 347, 386-90 (2000).

18. Other scholars have advocated radical reform of the intellectual property system without endorsing rewards. *See, e.g.*, Lester C. Thurow, *Needed: A New System of Intellectual Property Rights*, HARV. BUS. REV., Sept.-Oct. 1997, at 95.

instead of the patent system.[19] Steve Calandrillo has argued for a prize system for copyright as well as for patent.[20] Meanwhile, Michael Kremer has described a system in which patent recipients would agree to give up their patents in exchange for compensation that would be determined through a unique auction process.[21] Finally, Douglas Lichtman has suggested that the government could achieve the benefits of a prize system with much lower costs by keeping the patent system and subsidizing consumers who would value patented products above marginal cost but cannot afford them at the monopoly price.[22]

As the diversity of reward proposals indicates, there is no academic consensus on how a prize system should work, let alone on whether any particular prize system is advisable. Prize system advocates recognize that the devil is in the details and that the devil for a prize system is the government's ability to dispense rewards accurately. Although prize system proponents have given more or less developed indications of what the government should look to in determining awards, none has given an assessment from the perspective of public administration of how such an agency should function. That is the project of this Article, but the Article's aim is not to fill in obvious implementation details for such a regulatory scheme. Outlining a design for a regulatory agency charged with disbursing funds is a familiar, if not easy, task. Give rulemaking authority, authorize the appointment of commissioners, create hearing procedures, and appropriate funds, and the agency will work well enough. Or perhaps it will not work so well, which is the point of those who laud the copyright[23] and patent[24] system's ability to induce innovation with a relatively small amount of governmental involvement and expense.

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19. Steven Shavell & Tanguy van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525, 537-39 (2001).

20. Steve P. Calandrillo, *An Economic Analysis of Property Rights in Information: Justifications and Problems of Exclusive Rights, Incentives to Generate Information, and the Alternative of a Government-Run Reward System*, 9 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 301, 331-36 (1998).

21. Michael Kremer, *Patent Buyouts: A Mechanism for Encouraging Innovation*, 113 Q.J. ECON. 1137, 1147-48 (1998).

22. Douglas Gary Lichtman, *Pricing Prozac: Why the Government Should Subsidize the Purchase of Patented Pharmaceuticals*, 11 HARV. J.L. & TECH. 123, 124-25 (1997).

23. *See, e.g.*, Wendy J. Gordon, *Asymmetric Market Failure and Prisoner's Dilemma in Intellectual Property*, 17 U. DAYTON L. REV. 853, 868 (1992) (concluding that markets are likely to be superior to courts and administrative agencies in setting appropriate prices for use of copyrighted material).

24. As Dutton notes in explaining the reasoning of those who rejected prize systems in the nineteenth century, "Patents at least let the market decide." DUTTON, *supra* note 4, at 26.

This Article seeks to undermine a premise common to all of the recent proposals. The quest underlying the renaissance of scholarship on prize systems seems to be for a specification of just how such an agency should act in granting awards. If only the task of giving awards can be reduced to a formula or algorithm, it must seem, then the objection that government will not do the job right will go away. Specify the formula or algorithm in the statute governing the reward-granting agency, leaving as little bureaucratic discretion as possible, and the system will work just fine. I will argue, however, that there are so many considerations relevant to dispensing prizes, many of which cannot be measured in an objective way, that no proposal is likely to be successful in specifying adequately in advance just what result an agency should reach in each case. Even if academics could settle on a solution, and even if there were sufficient political will to effect a radical change in the patent system, Congress might not adopt the proper formula. Political considerations might interfere, and the ideal formula or procedure might be altered to benefit a key legislator's constituency or district. In addition, legislators might distrust formulas and procedures that would be difficult for even an economist to understand quickly. Congress could charge an administrative agency with the task of creating regulations for optimal disbursement of funds, but this solution just moves the problem to a new venue, with concerns about agency capture replacing concerns about special interest influence in Congress.[25]

Nonetheless, I do not argue that the administration of a prize system would be so fraught with difficulties as to make it infeasible. Because of the deadweight loss that exists when some consumers value a good at more than its marginal cost but less than its price under patent protection, even an imperfect prize system might improve social welfare relative to the patent system. If there are enough consumers who would not purchase a product in the patent system but would be able to afford it if the product were released in the public domain, the resulting increase in social welfare may well offset any decrease attributable to inadequate or excessive prizes. There is, however, a much more important reason that I do not conclude that a prize system is infeasible: The quest for the perfect formula or algorithm may be not only futile, but also unnecessary. An administrative agency given a degree of flexibility in awarding prizes might perform better than one hamstrung to a poorly designed formula or algorithm. There are two explanations for why previous

25. On capture theory and its successors, see Thomas W. Merrill, *Capture Theory and the Courts: 1967-1983*, 72 CHI.-KENT L. REV. 1039 (1997).

commentators have assumed that flexibility is an evil to be avoided by an appropriate constraint. The first is that an agency might do a haphazard job in awarding prizes, arbitrarily giving some patent holders too much and others too little. The second is that an agency might be systematically inaccurate, either giving all patent holders too much or all patent holders too little. There are, however, relatively straightforward antidotes to both of these problems, neither of which requires an elaborate formula.

The key to discovering the antidote to the first problem, that of haphazard decisionmaking, is the recognition that if a patent holder has no more reason to think that it is more likely to receive too much for a patent than that it will receive too little, the uncertainty is of relatively little consequence. A patent holder cares most about the expected returns, whether from the commercialization of a product or from an agency decisionmaker, and so the prospects of receiving too much or too little may well cancel out. Uncertainty, of course, imposes some cost on a patent holder. If a patent holder auctioned the right to a prize, as it might do if faced with a liquidity constraint, bidders presumably would offer somewhat less than the expected value of the prize to compensate for its variance.[26] But this cost need not be large. There are many other uncertainties associated with the development of patented products, and this would merely be a new such uncertainty. Moreover, uncertainty about prizes would replace uncertainty about commercial success. Even if the former were larger than the latter in most cases, only the marginal increase in uncertainty is of any concern at all. The danger of haphazard decisionmaking is therefore not large.

Haphazard decisionmaking, however, might still be a problem if the patent holder has the right to decline a governmental offer of a particular prize. This might seem to create an impossible choice for the designer of a patent prize system: Either a prize system could be mandatory, in which case it will be both politically impossible to implement and quite risky given the unproven empirics of any prize proposal, or it could be optional, in which case the only individuals to accept prizes would be those who believe that the government is willing to pay too much.[27] The flaw in this argument is the assumption that an optional prize system must give a patent holder an opportunity to decline participation after the government has determined a value for the patent. A straightforward alternative

26. A separate point is that bids might be depressed because of the "lemons" problem. *See infra* note 296 and accompanying text. This, however, does not reflect an increased cost of uncertainty, but merely a difficulty of alienating rights to prizes.

27. *See infra* Part II.C.1.

would be to make selection of a prize system an optional alternative to the usual approach to pursuing a patent but to make decisions on opting into a prize system irrevocable. That is, if a patent holder chose to place a patent in the public domain and to receive a prize, then it could not change its decision if the prize turned out to be smaller than hoped. Just as a patent holder who pursues commercialization of a patent does so for better or for worse, so too a patent holder who chooses a prize would do so for richer or for poorer.

A prize system structured in this way can achieve the particularism that is a virtue of the common law in a context that, because of the subjectivity of government spending decisions, is not easily amenable to the crafting of doctrine and precedent. The government may be able to induce efficient private allocation of funds toward achieving desired social goals even if the government itself would never be able to make funding decisions in an optimal way. The possibility of government failure is not an argument against a retrospective prize system, but an argument for it. The decisions that matter most in a prize system are not those of the government, but rather those of private parties predicting what the government will do. In this context, there are two such decisions: first, whether to invest in research and development of a product; and second, whether to place the product in the public domain or to take some other action to reduce the deadweight costs associated with patent protection. Creation of an optional prize system will generally increase incentives for research and development, with greater increases for larger total amounts of government funding, although the overall effect may be small since patent holders will have to sacrifice monopoly profits if they wish to receive a prize. Meanwhile, if the government gives a reward for taking an action to reduce deadweight loss, even if we are sure that the government's decisions will be haphazard, the prediction of what an average governmental decisionmaker will do in a particular case may be quite close to optimality. Thus, even if there is no perfect formula or algorithm for determining the size of prizes, an administrative agency given the flexibility to make a prize determination, either from whole cloth or by starting with a formula or algorithm and making appropriate adjustments, might be expected to make the right decisions on average. Because that is all that matters, the random errors associated with haphazard decisionmaking are not a significant concern.

This conclusion leaves the second concern about flexibility, that prizes might be systematically too low or too high. This concern, however, is greatly reduced with an optional program. If the government gives prizes that are too low, fewer patent holders will opt

into a prize system by placing their patents into the public domain. An agency that tries to shortchange patent holders will feel the costs of its approach almost immediately, with fewer firms opting into the system in response to the agency's decision. This is in contrast to a mandatory system, where the costs of shortchanging applicants might be distant, affecting only future decisions about whether to develop products, thus giving agency administrators with short time horizons incentives to pay too little.[28] At the same time, an agency that pays too much will face pressure from Congress and indirectly from taxpayers, with the eventual result of excessive spending likely to be the termination or reduction of the program. Of course, interest groups may advocate continued funding of inefficient programs, but they may seek to obtain government subsidies in any event, and at least even excessive spending in this area would induce increased research and development.

Most significantly, Congress can eliminate the problem of systematic errors by capping the amount that the agency may spend. If an agency, for example, can spend $1 billion, then industry will not be able to capture the agency and receive undeserved funds simply by inducing the agency to make favorable assessments, because the agency would not be able to spend any more than the congressional appropriation. A cap is particularly useful for an experimental program, with larger appropriations possible should a modest program initially turn out to be successful. At the same time, Congress can prevent undercompensation by requiring that an agency spend whatever it has been appropriated. A statute could simply require the agency to determine the value of each project for which a prize is sought and then distribute the available funds proportionately, regardless of whether the assessed values aggregate to less than or more than the total size of the fund. For example, if the combined total of all prize submissions equaled $500 million for a $1 billion fund, then each applicant would receive twice the assessed value; if the total were $2 billion, each applicant would receive only fifty cents on the dollar.

It might seem that giving an agency a certain amount of money to spend, regardless of the number of projects it receives, entails a substantial risk. After all, if projects providing only $500 million in social value deplete a $1 billion fund, the government in effect has lost $500 million. This risk is not a significant concern, however, and not only because the loss would simply be a transfer rather than a real economic loss. The provision of a $1 billion fund will lead to private

28. *See, e.g.*, JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 401 (1988).

expenditures of close to that amount to obtain the money; this response is the simple logic of market incentives. Because placing a patent in the public domain reduces deadweight loss, there are likely to be many applications for which the social value of placing a patent in the public domain is greater than the corresponding private sacrifice in terms of reduced revenues from a patent. Thus, especially with an initial experimental program, while the risk and uncertainty of the prize system may mean that the total sacrifice of monopoly profits is slightly less than $1 billion, the aggregate social value of projects is likely to be considerably *greater* than the total amount that the government offers. Those who opt into the fund, moreover, will be those for whom any increase in risk is worth it. That group will include those who believe that their projects will rate as producing high social value despite relatively little private sacrifice, precisely those whom we would most like to induce to participate in a prize system.

A prize system, of course, is not costless. Significant costs are incurred for the prizes themselves and for the administrative apparatus, and any distortionary effects of taxation needed to meet such costs must be balanced against the benefits of a prize system. There are several reasons that a retrospective prize system is particularly appropriate as a supplement to the patent system, whatever the virtues of using prizes in other administrative contexts outside the patent area. First, the deadweight loss that a system of patent prizes may help eliminate makes any costs associated with the prize system worth bearing. Second, a patent prize system may help reduce redundant research—for example by a firm seeking to invent around a patent. Third, replacing markets with prize systems may obscure the important role that prices serve in helping to coordinate economic activity. This coordinating function is more important in some contexts than in others. It is relatively unimportant in the patent context, because research-and-development expenditures are made far in advance of profits from a patent.

The Article proceeds as follows. Part I critically reviews the recent literature urging acceptance of reward mechanisms in the patent context. It begins by identifying weaknesses in each of the major proposals for a comprehensive system that either would replace the patent system or would be available for inventors as an alternative to it. While my purpose is partly to critique the mechanics of the proposals, it is more broadly to emphasize that any approach is likely to have advantages and disadvantages.

Part II then identifies potential obstacles for any such comprehensive system. Problems include inadequate incentives for

commercialization, deadweight loss attributable to the distortionary effect of taxes, redundant research effort by competitors, noncompetitive markets for production or distribution of goods, lack of incentives for adequately screening reward applications, high administrative costs, and rent-seeking.

Part III argues for a system that provides more flexibility to agency decisionmakers. This argument provides support for an agency that is simply given a sum of money to distribute to those who have placed patents in the public domain or taken other actions, such as lowering prices, that decrease the deadweight costs associated with patent. Although it seems politically unlikely that such an agency could replace the patent system, the simplicity of this approach may make it attractive as a complement to the patent system. At the same time, an agency might use a technique similar to one of those sketched out in Part I, but with modifications that either allow one proposal to take advantage of the insights of another or that provide greater flexibility for the agency administering the proposal. Part III concludes by suggesting how changes might be made to each of the proposals sketched in Part I to make them more attractive.

I. THE LIMITS OF PATENT PRIZE PROPOSALS

This part considers four recent proposals to establish patent prize systems. The proposals exhibit a remarkable diversity in approach. All, however, share the goal of addressing how the government might determine the size and form of prizes. The earliest proposal, in Part I.A, imagines that the government would use its eminent domain power to take certain patents, with a "market test" available to patent holders to challenge the size of the prize given. The proposal in Part I.B, by contrast, seeks to derive a formula that a government agency could use in providing prizes, and the proposal in Part I.C describes a market mechanism involving auctions and randomization for determining how much should be paid in patent buyouts. The most distinctive of the proposals is that in Part I.D, which urges that the government give prizes in the form of coupons instead of buying out patents. Besides describing the proposals, I aim to show that each has significant flaws and that even if these flaws could be corrected, different approaches might be optimal in different situations.

A. Guell and Fischbaum's Market Test

Robert Guell and Marvin Fischbaum offered the first of the recent proposals for prize systems, focusing specifically on the prescription drug industry.[29] Their proposal is useful initially for describing the central problem that all proposals for patent prizes seek to attack: the inefficiency associated with the grant of a limited monopoly.[30] As Guell and Fischbaum explain, "[t]he problem is that, in order to garner [monopoly] profits, monopolists set price above marginal cost and produce less than the socially desirable output."[31] By definition, a profit-maximizing firm will raise its prices on a product until the decrease in the number of consumers purchasing the product more than offsets the profit attributable to the higher price paid by consumers who will still buy it. If the producer can prevent other firms from selling the same product, as a patent entitles the producer to do,[32] then the price the producer ordinarily charges will be more than it costs to make an additional unit of the product. A pill that costs just a few cents to manufacture might sell for tens or hundreds of dollars.

This story is familiar, but two points are worth emphasizing. First, as Guell and Fischbaum note, "monopoly profits per se are not a cause for concern."[33] The economist's standard objection is not that the drug producer will get rich at the expense of consumers—a distributional issue.[34] The economist worries about the effect of an increase in price on production.[35] Some consumers who value the drug at more than the price it costs to manufacture the drug will fail to purchase the drug at the monopoly price, either because they decide that their money is better spent elsewhere or because they do not have

29. Robert C. Guell & Marvin Fischbaum, *Toward Allocative Efficiency in the Prescription Drug Industry*, 73 MILBANK Q., June 1995, at 213.

30. *See, e.g.*, ROBERT B. EKELUND, JR. & ROBERT D. TOLLISON, ECONOMICS 273-74 (3d ed. 1991) (describing the welfare losses associated with the exercise of monopoly power).

31. Guell & Fiscbbaum, *supra* note 29, at 216-17.

32. *See* 35 U.S.C. § 271 (2000) (prohibiting infringement of a patent). Excludability is, of course, the essence of the patent right.

33. Guell & Fischbaum, *supra* note 29, at 216.

34. *See generally* Louis Kaplow & Steven Shavell, *Why the Legal System Is Less Efficient Than the Income Tax in Redistributing Income*, 23 J. LEGAL STUD. 667 (1994).

35. This emphasis is apparent in George Stigler's Coasean observation that in a world of zero transaction costs, consumers could pay a monopolist to increase output. *See* George J. Stigler, *The Law and Economics of Public Policy: A Plea to the Scholars*, 1 J. LEGAL STUD. 1, 12 (1972). In effect, in a patent prize system, the government serves as the consumers' representative in making just such a bargain with a patent holder.

sufficient resources to make the purchase.[36] When this outcome occurs, "consumers lose more from higher prices than producers gain,"[37] and a deadweight loss results. Second, the economist's concern may not be the same as the politician's concern. To be sure, politicians sometimes worry publicly about individuals being denied health care.[38] It is at least as common, however, for politicians to complain about the effect of the high cost of prescription drugs, sometimes on specific groups like senior citizens.[39]

Of course, the possibility of deadweight loss is not by itself sufficient to justify eliminating the patent system. Guell and Fischbaum recognize that the "static efficiency" from elimination of the patent system might be outweighed by the system's "dynamic efficiency."[40] Elimination of patent protection would produce a short-term benefit, as the price of products currently inflated because of patents falls.[41] It would, however, discourage producers from innovating in the future. The end of patents would not be the end of invention altogether. Innovators might still be able to protect some inventions by keeping them secret.[42] In addition, research and development might be worthwhile because of first-mover advantages.[43] In a survey, chief research-and-development executives

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36. This phenomenon occurs because consumers' demand for the drug is not completely inelastic. *See* EKELUND & TOLLISON, *supra* note 30, at 119-22 (explaining elasticity).

37. Guell & Fischbaum, *supra* note 29, at 217.

38. *See, e.g., Gore Vows Penalties If HMOs Cut Seniors*, DES MOINES REG., Sept. 26, 2000, at 8, *available at* 2000 WL 4975826 (describing Al Gore's criticism of drug companies for refusing coverage and dropping patients).

39. *See, e.g., GOP Rips Al's Far-Fetched Story on Pooch's Drug Prices*, N.Y. POST, Sept. 19, 2000, at 4 (discussing a controversy involving Gore's allegation that his mother-in-law paid more for arthritis medication than the price of the same drug for his dog).

40. Guell & Fischbaum, *supra* note 29, at 221.

41. This assumes that the government could eliminate the patent system without providing compensation, which is unlikely given the Takings Clause. *See* Mitchell N. Berman et al., *State Accountability for Violations of Intellectual Property Rights: How to "Fix"* Florida Prepaid *(And How Not To)*, 79 TEX. L. REV. 1037, 1072 (2001) ("[S]tate infringements of patents, copyrights, and trademarks are likely in some cases to constitute takings of intellectual property that will require the state to pay just compensation to the rightsholders."); *see also* Shubha Ghosh, *Toward a Theory of Regulatory Takings for Intellectual Property: The Path Left Open After* College Savings v. Florida Prepaid, 37 SAN DIEGO L. REV. 637 (2000) (arguing that state infringement of intellectual property might be remedied by takings suits, despite state sovereign immunity).

42. *See* Vincent Chiappetta, *Myth, Chameleon or Intellectual Property Olympian? A Normative Framework Supporting Trade Secret Law?*, 8 GEO. MASON L. REV. 69, 136-45 (1999) (analyzing the relationship between trade secret law and patent law).

43. For a classic study of the advantages of being a first mover, see Richard Schmalensee, *Product Differentiation Advantages of Pioneering Brands*, 72 AM. ECON. REV. 349 (1982). *See also* Cecelia A. Conrad, *The Advantage of Being First and Competition Between Firms*, 1 INT'L J. INDUS. ORG. 353 (1983); Paul Klemperer, *Entry Deterrence in Markets with Consumer Switching Costs*, 97 ECON. J. 99 (1987). For an assessment of whether first-mover advantages would be

acknowledged that many of their inventions would have been developed even in the absence of patent protection, more in some industries than in others.[44] A drawback of the patent system is that it covers, perhaps by necessity, both inventions spurred by the promise of a monopoly and inventions that would have been developed in any event.[45] Deadweight losses will exist not only for inventions that would never have existed but for the patent system, but also for inventions that would have existed anyway.

Nonetheless, it is at least theoretically plausible that the benefits of the patent system exceed the costs,[46] and for the purposes of this Article, we will assume this supposition to be true. Patent advocates cannot end the inquiry here, though, because the question is whether it is possible to provide incentives for the inventions that the patent system offers without suffering the deadweight loss inherent in monopoly pricing. One way that this outcome might be achieved is by having the government provide funds for research and development directly, with requirements that the results of the research be released and shared with the public. If research is a public good, let it be publicly produced, the argument goes. The government, of course, does just this with basic research, conducting much basic research itself and providing subsidies for other basic research.[47] Governments,

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sufficient to spur innovation in the pharmaceutical industry, see F.M. SCHERER & DAVID ROSS, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 588-92 (3d ed. 1990). Calandrillo specifically discusses first-mover advantages in considering the virtues of prize systems. Calandrillo, *supra* note 20, at 318-21.

44. *See* Edwin Mansfield, *Patents and Innovation: An Empirical Study*, 32 MGMT. SCI. 173, 175 (1986). "Weighting the responses according to 1982 company-financed R&D expenditures in the reporting groups, the aggregate loss of inventions without patent protection would have been roughly 14 percent of those actually made." SCHERER & ROSS, *supra* note 43, at 629 (basing the calculation on National Science Foundation data). For a more recent survey suggesting that executives generally view patents as a relatively ineffective way of protecting intellectual property, but that reliance on patents may have increased since the Levin et al. study, see WESLEY M. COHEN ET AL., PROTECTING THEIR INTELLECTUAL ASSETS: APROPRIABILITY CONDITIONS AND WHY U.S. MANUFACTURING FIRMS PATENT (OR NOT) (Nat'l Bureau of Econ. Research, Working Paper No. 7552, 2000).

45. Some commentators have suggested enforcing only patents on inventions that would not have been developed in the absence of patent law. *See, e.g.*, A. Samuel Oddi, *Beyond Obviousness: Invention Protection in the Twenty-First Century*, 38 AM. U. L. REV. 1097, 1101 (1989); *see also* Roberts v. Sears, Roebuck & Co., 697 F.2d 796, 798 (7th Cir. 1983) (Posner, J.) (employing such reasoning).

46. Even if the patent system imposes greater costs than benefits for run-of-the-mill inventions, its benefits may exceed its costs once truly revolutionary inventions are taken into account, since these may require "completely new marketing channels and production facilities." A. Samuel Oddi, *TRIPS—Natural Rights and a "Polite Form of Economic Imperialism,"* 29 VAND. J. TRANSNAT'L L. 415, 442 n.112 (1996) (quoting F.M. SCHERER, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 448 (2d ed. 1980)).

47. The United States typically performs basic research itself instead of subsidizing research when the research is aimed at direct government use—for example, for national

however, may be unsuccessful at picking winners,[48] and in particular at deciding what type of research is important and who is best suited to perform it.[49] Even if the government knew what invention it would like developed and who is best situated to develop it, Guell and Fischbaum argue that inefficiencies in government contracting may make direct procurement "a recipe for disaster."[50] Presumably, the government encourages research with both patent protection and subsidization of research because each approach is the more efficient in its own sphere.

Enter the proposal for a prize system. Instead of having the government only choose ex ante what research projects to finance, the government could allow the invisible hand to work, inventors to obtain patents, and then pay the inventors for their patents. Guell and Fischbaum propose simply "that the government buy prescription drug patents at a price equaling the net present value of the profit they would have generated and distribute the patents to U.S. drug manufacturers."[51] Assuming that the government could do this, it is easy to see how this approach would solve the deadweight loss

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defense. *See* Michael L. Doane, *Green Light Subsidies: Technology Policy in International Trade*, 21 SYRACUSE J. INT'L L. & COM. 155, 160 (1995).

48. Michael Hart, for example, argues, "Governments do not have a good track record of picking winners and losers, but losers have an excellent record of picking governments. When governments are committed to picking winners, the losers will show up and insist on their share . . . ." Michael Hart, *The Chimera of Industrial Policy: Yesterday, Today and Tomorrow*, 19 CAN.-U.S. L.J. 19, 36 (1993); *see also* Steve Charnovitz, *Designing American Industrial Policy: General Versus Sectoral Approaches*, 5 STAN. L. & POL'Y REV. 78, 85 (1993) (noting the difficulty that the government faces in establishing adequate criteria for picking winners). One problem with the critique that government is ineffective at picking winners is that the private sector has its share of losers too, from the Edsel to New Coke. On the other hand, when the government seeks to pick winners, even when it seems to be successful, it may have literally picked the winners by creating an uneven playing field. *See* Joel B. Eisen, *Antitrust Reform for Joint Production Ventures*, 30 JURIMETRICS J. 253, 254-55 (1990).

49. For an extended argument against government financing of science, see TERENCE KEALEY, THE ECONOMIC LAWS OF SCIENTIFIC RESEARCH (1996).

50. Guell and Fischbaum note that the government could accomplish procurement either through fixed-cost pricing, in which a contractor agrees to do research for a set fee, or cost-plus pricing. Guell & Fischbaum, *supra* note 29, at 222. Fixed-cost pricing "can lead to cost minimization without regard to quality." *Id.* It is particularly problematic for research whose prospects are uncertain and for which assessments ideally should be made each step of the way whether the research should continue or be scrapped as a sunk cost. Cost-plus pricing solves some of these problems, but "invariably this results in cost overruns because the builder does not share in the savings." *Id.* at 223. Government contracts law, of course, is all about trying to overcome these problems, but agency costs may be substantial for some types of government procurement. *See* William E. Kovacic, *Whistleblower Bounty Lawsuits as Monitoring Devices in Government Contracting*, 29 LOY. L.A. L. REV. 1799, 1806-07 (1996) (noting that while the government may overcome agency costs by allowing whistleblower lawsuits, these lawsuits entail agency problems of their own).

51. Guell & Fischbaum, *supra* note 29, at 221.

problem. By allowing free use of the patent by manufacturers,[52] the government would invoke competitive forces, leading to production at a level that normally would be higher than the monopoly output level at a lower price. The inventors should be indifferent, assuming that the government gives them precisely the difference between the profits that they would have earned and the profits that they might still earn from being one producer of the drug among many. As Figure 1 illustrates, the patent buyout benefits society as a whole by eliminating deadweight loss, while leaving pharmaceutical companies indifferent. Indeed, pharmaceutical companies might even benefit, because free distribution of drugs might provide positive publicity for them, or at least less negative publicity than they currently receive for "price gouging."[53]

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52. Guell and Fischbaum do not explain why only U.S. drug manufacturers would be entitled to produce the drugs, though this approach could satisfy a protectionist motive. An alternative nonprotectionist approach would be to distribute the patent to all manufacturers producing the drug for distribution in the United States. This solution would allow the inventor to obtain and enforce patents abroad, unless of course foreign countries also adopted a prize system. Guell and Fischbaum do recognize the international nature of the patent system and that the size of the U.S. economy may mean that the optimal solution for it is different from that for a small country:

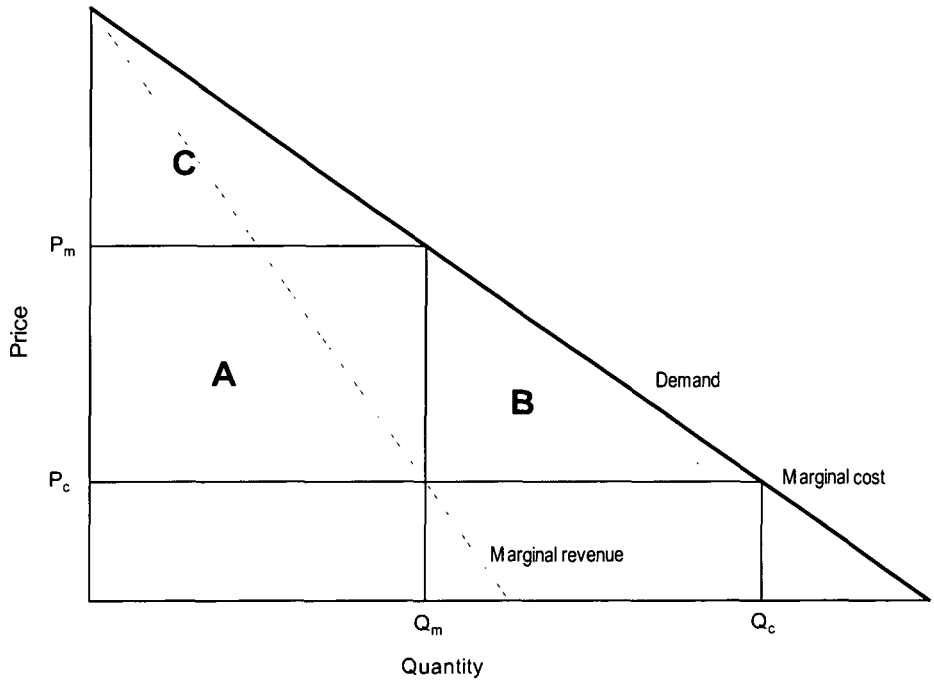
> [A]n absence of a measurable effect of price controls on R&D in smaller markets would not necessarily provide support for price controls in the United States because these are clearly "beggar-thy-neighbor" policies, which allow other nations to benefit from high U.S. prices. If high U.S. prices serve to motivate drug research globally, the existence of price controls in a "small country" would have minimal impact on the level of R&D investment in that country. Because the United States provides the largest national market for pharmaceuticals, price controls here would have a very different impact; it would induce a significant drop in R&D not only in the United States, but elsewhere as well.

Id. at 222. Of course, even a small country might rationally adopt a patent system to achieve reciprocity benefits for its own inventions. *But see* A. Samuel Oddi, *The International Patent System and Third World Development: Reality or Myth?*, 1987 DUKE L.J. 831 (1987) (arguing that membership in the international patent system may harm third-world nations).

53. *See, e.g.*, Christopher Connell, *Drug Prices Rising Faster Than Inflation, Senators Complain*, ASSOCIATED PRESS, Feb. 3, 1993, *available at* 1993 WL 4525594 (discussing accusations that the drug industry was "price-gouging" consumers).

Figure 1: Economic Effects of a Patent Buyout

A profit-maximizing patent holder will choose the monopoly price P_m and quantity Q_m. Rectangle A represents a monopoly rent, the profits that the patent holder receives as a result of the patent. The monopoly pricing produces a deadweight loss represented by triangle *B*, and consumer surplus with monopoly pricing is equal to triangle *C*. In a patent buyout, the government pays to the patent holder an amount equivalent to rectangle *A*, thus leaving the patent holder as well off as it would have been before. The patent is then placed in the public domain, and competition results in a price P_c and quantity Q_c. Consumer surplus is now the sum of *A*, *B*, and *C*. The patent buyout thus increases consumer welfare by the sum of *A* and *B* for a cost of *A*, resulting in a total increase in social welfare equivalent to *B*.



Guell and Fischbaum's primary contribution is in setting forth the analytic case for a prize system. It will be worthwhile, though, to consider how Guell and Fischbaum propose implementing the scheme, while in fairness recognizing that the specific proposal is not the central point of their paper. Guell and Fischbaum suggest initially that the government confiscate patents, much as it confiscates other goods for public use and pays just compensation under the Takings Clause.[54] This solution is analytically simple, placing aside the

54. Guell & Fischbaum, *supra* note 29, at 225. There is historical precedent for the government's taking of a patent. *See* City of Milwaukee v. Activated Sludge, Inc., 69 F.2d 577 (7th Cir. 1934).

question of how to create an administrative agency that would determine which patents to take. It does not, however, explain just how the courts would determine the amount of compensation, and even Guell and Fischbaum do not have full confidence in the results of eminent domain proceedings, characterizing the process as one in which "wholly unqualified judges determine the 'just compensation' based on two competing claims of value."[55] As a result, Guell and Fischbaum advocate "the possibility of a market appeal," in which a drug would be marketed "in a specific test area," with the firm's "scaled-up profits" used as "an indicator of the firm's true monopoly profits had it kept the patent."[56]

This proposal has a number of problems. First, while the market appeal is designed to offset the danger of judges "biased against inventing firms,"[57] there is the possibility that judges, whether biased or not, sometimes might provide valuations that are higher than necessary.[58] To offset that bias, one might allow the government to use the market appeal too, but if that is so, then the eminent domain process essentially reduces to a form of nonbinding arbitration,[59] perhaps useful but essentially just a first act to the market appeal. Second, the market appeal will result in a delay in selling the product. Guell and Fischbaum explain, "Because the drug would be sold only within the test region, no one would leave the area to buy the drug at a cheaper price."[60] Thus, some consumers (including some who would be willing to pay the monopoly price)[61] would be

55. Guell & Fischbaum, *supra* note 29, at 225.

56. *Id.*

57. *Id.*

58. Guell and Fischbaum contend that "[t]he purchasing agency would have an incentive to state the [patent value] accurately because a history of being proved wrong in test markets would lead judges to side more often with firms." *Id.* The purchasing agency, however, might systematically provide overly generous offers as a way of avoiding market appeals. Even if the purchasing agency tried to state the patent value accurately, however, the purchasing agency sometimes might give overly generous offers inadvertently, and neither side would appeal in such cases.

59. Nonbinding arbitration may be useful, for example by encouraging settlement. *See, e.g.*, Steven A. Weiss, *ADR: A Litigator's Perspective*, BUS. L. TODAY, Mar./Apr. 1999, at 30, 30 ("From my experience, nonbinding arbitration is only useful when the parties have litigated for a while, discovery is mostly or completely finished, and the parties are trying to reach a settlement."); *see also* Kathryn L. Hale, Note, *Nonbinding Arbitration: An Oxymoron?*, 24 U. TOL. L. REV. 1003 (1993) (exploring the usefulness of nonbinding arbitration).

60. Guell & Fischbaum, *supra* note 29, at 225.

61. Under current doctrine, the test market period would need to occur after or shortly before the patent application is filed. *See* Jay David Schainholz, Note, *The Validity of Patents After Market Testing: A New and Improved Experimental Use Doctrine?*, 85 COLUM. L. REV. 371, 371-72 (1985) (noting that market testing does not count as an experimental use permissible more than one year prior to filing a patent application). To minimize the period during which the drug would be available only in a test market, Congress might consider expanding the

excluded for a time from obtaining the product, producing a deadweight loss.

Third, and most significantly, it might be difficult to extrapolate from the results in the test market. Perhaps the particular geographic area in which the test market is conducted has different demographics from the nation as a whole. Moreover, the test period may not be representative. As Guell and Fischbaum themselves recognize, "the ultimate effectiveness of [a] new drug is uncertain,"[62] but they fail to recognize that a brief test market period may be inadequate. A drug may initially be popular, but later prove less effective than originally believed,[63] or it may take time for a drug to catch on among prescribing doctors.[64] Indeed, Guell and Fischbaum note that a drug ultimately may prove beneficial for other than its initially intended use,[65] but such uses may take more time to become apparent. Guell and Fischbaum urge that the pharmaceutical company be encouraged to advertise the drug and that the price of marketing efforts be taken into account in determining the profits from the drug. But advertising expenditures may be quite different for the initial introduction of a drug than they would be later.[66]

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experimental use exception. Alternatively, the output-reducing effect of the test market could be mitigated by allowing the patent holder to sell the drug nationwide until the buyout is completed. Indeed, the test market could simply be a "test period" in which the drug was marketed nationwide. Such sales, however, would still be at the monopoly price, thus implying some welfare loss relative to a system that effected patent buyouts at the beginning of a patent term.

62. Guell & Fischbaum, *supra* note 29, at 224.

63. In an extreme case, a drug may be withdrawn because of unexpected safety problems. *See, e.g.*, Vanessa Fuhrmans & Gardiner Harris, *Bayer Withdraws Major Cholesterol Drug*, WALL ST. J., Aug. 9, 2001, at A3 (reporting on Bayer's withdrawal of Baycol, a cholesterol-lowering drug, after at least thirty-one deaths among patients taking the drug).

64. Capital markets, however, often react strongly to unexpectedly slow drug sales, suggesting that initial sales may well be predictive of future sales. *See* Susan Pulliam & Thomas M. Burton, *Investors Focus on 'Scrip Sales' of New Drugs like Lilly's Evista, and Punish Slow Takeoffs*, WALL ST. J., Feb. 19, 1998, at C4 (discussing investors' consideration of "scrip sales," weekly reports on the sales of prescription drugs, particularly new ones).

65. "In medical research the unintended beneficial qualities of medicines are often as important as the intended ones. Temin [1980], for example, relates how research on sulfa drugs led to whole new classes of therapeutic agents, including tranquilizers and antihypertensives." Guell & Fischbaum, *supra* note 29, at 224 (citing P. TEMIN, TAKING YOUR MEDICINE: DRUG REGULATION IN THE UNITED STATES (1980)). As this quotation reveals, not only might a particular drug have beneficial but possibly unforeseen uses, but it also might serve as a building block to another invention. A patentee can take advantage of this either by developing the subsequent invention or by licensing, but the test market approach would not help to calculate potential profits from such activities.

66. One commentator has argued that determining the value of patents in the prescription drug contexts is complicated by the existence of insurance. *See* Arti K. Rai, *The Information Revolution Reaches Pharmaceuticals: Balancing Innovation Incentives, Cost, and Access in the Post-Genomics Era*, 2001 U. ILL. L. REV. 173, 179 (2001) ("[T]he growing number of

I do not mean to imply that these problems could not be overcome or that they are so severe as to make Guell and Fischbaum's proposal inadvisable. A government agency might be able to develop detailed demographic models allowing it to extrapolate from a test market to the country as a whole. Similarly, the agency might rely on data about profits from pharmaceuticals in the past to estimate future advertising and sales of a drug from the initial sales in a test market. Moreover, one might argue, as long as the agency is not systematically wrong, the system might produce the appropriate invention incentives.[67] There is, however, the possibility that the agency will be systematically wrong—that it will adopt a formula or procedure for computing the value of a patent that is inaccurate in a predictable way. Such a systematic error might have a substantial effect on innovation incentives, either positive or negative, if it changes the expected returns to research and investment. While Guell and Fischbaum's proposal is a first step, they do not offer enough details or argument to justify a belief that the agency would be able to manage its task sufficiently well.

B. Shavell and van Ypersele's Reward Formula

The Shavell and van Ypersele model is in presentation nearly the polar opposite of Guell and Fischbaum's proposal. While Guell and Fischbaum explain their proposal primarily with words, using a figure only to convey the concept of deadweight loss, the Shavell and van Ypersele proposal is based on and developed through a mathematical model. The motivation for the Shavell and van Ypersele project is the recognition that the "principal difficulty with reward systems . . . concerns the government's need for information to calculate rewards."[68] Following an earlier model by Brian Wright,[69] they worry

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commentators who advocate publicly financed buyouts of important pharmaceutical patents as a means of eliminating deadweight loss ignore the demand-side reality that for the most part, individual consumers do not purchase individual drugs directly at the time they need them.") (footnote omitted). Guell and Fischbaum might respond to this criticism by noting that it does not matter from the perspective of the market test whether drugs are purchased by insurance companies or by consumers. This response, however, only highlights the problem that insurance companies' purchasing and reimbursement decisions in the test market might not be reflective of their later decisions. An alternative response would be to prevent insurance companies from providing the drug in the test market as a way of gauging consumer demand independent of moral hazard.

67. This argument is quite similar to one that I will offer later. *See infra* text accompanying notes 386–87.

68. Shavell & van Ypersele, *supra* note 19, at 526.

69. Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 73 AM. ECON. REV. 691 (1983).

particularly about asymmetric information. This focus is sound. If both the inventor and the government have the same estimate of the value of a patent, then a patent buyout at that value will be efficient even if it turns out that the patent's estimated value is wildly inaccurate. The government is less risk-averse than a private party, and all that matters is providing equal value on average. What is worrisome is that the private party might have a better sense of the value of its patent than does the government. Systematic errors in calculating the value of patents might distort innovation incentives, perhaps enough to overwhelm the benefit from eliminating the deadweight loss associated with a patent regime.[70]

Shavell and van Ypersele model the asymmetric information problem by assuming that the inventor and the government have different information about demand for the product. In particular, the innovator knows the demand curve, but the government does not.[71] The government can identify only a family of demand curves to which the innovator's demand curve may belong, and it can calculate the probability that any of these demand curves is the actual demand curve.[72] Given these assumptions, Shavell and van Ypersele compare the surplus that would result in various possible regimes to the social

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70. Shavell and van Ypersele offer the following explanation as a prelude to the model:

> On one hand, the reward system is superior to patent in that deadweight loss due to monopoly pricing is avoided under rewards. On the other hand, the incentive to invest in research is imperfect under both systems, but in different ways. Under the patent system, the incentive to invest is always inadequate because monopoly profits are less than social surplus; but the incentive to invest is linked to actual social surplus because the innovator knows the demand for the potential innovation. Under the reward system, the incentive to invest is governed by the reward and thus is not systematically inadequate; yet the incentive to invest is not linked to actual surplus but only to the reward.

Shavell & van Ypersele, *supra* note 19, at 530 (footnotes omitted).

71. Shavell and van Ypersele recognize that in practice neither the innovator nor the government will know the demand curve and that the innovator's information will merely be better than the government's. They explain, however, that the assumption of perfect knowledge on the part of the innovator is a useful simplification:

> The assumption that the innovator has perfect information about demand (since he knows t) and that the government does not is the simplest way to reflect the idea that the innovator possesses superior information about demand. A more realistic assumption is that the innovator's information about demand is not perfect but still is better than the government's, and were this the assumption, it will be obvious that the qualitative nature of our results would not be altered.

Id. at 532 n.25.

72. Mathematically, the inverse demand function d reports the price as a function of the quantity of the product q and a parameter t. *Id.* at 531. The inventor knows the parameter t, but the government only knows a minimum and a maximum possible value of the parameter, denoted t_a and t_b, as well as the probability that any particular value within that range will be the actual value, represented by the probability density function $g(t)$.

surplus that would result from the "first-best outcome,"[73] in which a potential innovator invests the socially optimal amount in seeking to develop the innovation, and, if the innovation is successful, prices the product at its marginal cost.[74] The surplus will be less than optimal in a standard patent regime for two reasons, both familiar to the economic literature on patents.[75] The first reason is the deadweight loss from the patent holder's pricing the product at the monopoly level. The second follows from the first. Because deadweight loss is the portion of consumer's surplus in competition not transferred to producer's surplus,[76] the patent holder's profits will necessarily be less than the social surplus in the first-best outcome. As a result, the innovator will invest less in research initially than is socially optimal.[77]

The first original contribution offered by Shavell and van Ypersele is a comparison of the reward and patent regimes in their model. If the government's information were identical to the innovator's,[78] the government could achieve the first-best outcome simply by paying the innovator the social surplus. The deadweight loss would be eliminated, as the invention passes into the public domain and is manufactured at marginal cost.[79] In addition, the prospective innovator would invest the socially optimal amount in seeking the innovation, because paying the innovator the full social surplus allows the innovator to internalize the benefits of the innovation.[80] With imperfect information, however, the government does not know the social surplus, and it can thus promise the inventor

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73. *Id.* at 532.

74. Shavell and van Ypersele explain, "If there is an innovation, the first-best quantity, denoted $q(t)$, is such that the height of the demand curve is c, that is, $d(q(t),t) = c$." *Id.*

75. *See* TIROLE, *supra* note 28, at 399-400. For an additional treatment, see SCHERER & ROSS, *supra* note 43, at 622-24.

76. For a graphical illustration, see WALTER NICHOLSON, MICROECONOMIC THEORY: BASIC PRINCIPLES AND EXTENSIONS 574 fig.19.5 (5th ed. 1992). The illustration shows that monopoly pricing results in inputs that would have been devoted to the product being transferred to other, less productive uses in the economy.

77. "Under the patent system, there are two sources of welfare loss relative to first-best welfare: insufficient investment in research and insufficient quantity of the innovation product sold, with accompanying deadweight loss, due to monopoly pricing." Shavell & van Ypersele, *supra* note 19, at 534.

78. Shavell and van Ypersele note that this is "contrary to our assumption." *Id.* Differently stated, this is the result that would obtain if $t_a = t_b$.

79. *Id.* (explaining that "the quantity produced is always optimal, $q(t)$, under the reward system").

80. *Id.* ("[T]he innovator would then choose $k(s^*(t))$, the first-best investment in research."). The notation $k(s^*(t))$ means that the innovator will invest an amount k corresponding to an anticipated profit of $s^*(t)$, the social surplus given demand parameter t, if the research successfully leads to an innovation.

only what it expects the social surplus to be.[81] That is, the government calculates the probability of each possible social surplus, based on its knowledge of the probability distribution of the demand parameter, and it awards the inventor the average expected social surplus.

According to this approach, the prize system will continue to eliminate the deadweight loss.[82] It will, however, lead to an inefficient amount of research. If the expected value of the social surplus for a particular innovation is lower than the actual social surplus, then the innovator will invest too little in the project. In such a case, the innovator recognizes that the government will underestimate demand for the product and thus anticipates a smaller-than-ideal reward. If, however, the expected value of the social surplus is higher than the actual social surplus, then the innovator will invest too much in the project. In such a case, the innovator recognizes that government will overestimate demand for the product and thus anticipates a higher-than-ideal reward. Recall, however, that a patent regime also fails to optimize investment in this model, systematically producing too little of it.[83] Thus, while Shavell and van Ypersele conclude as a formal matter that either the patent or the prize system may be superior to the other, the informal case for reward seems strong. Patent can dominate reward in their model only if the investment inefficiency in a prize system is so much greater than the investment inefficiency in a patent system that it outweighs the benefit of the prize system in eliminating deadweight loss.[84] Whether this is so depends on the relative efficiency in producing optimal investment of the patent and prize systems, as well as on the relative importance of calibrating research incentives and eliminating deadweight loss.[85]

Shavell and van Ypersele's most important insight is that an optional reward program can dominate patent. They suggest that the

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81. Shavell and van Ypersele demonstrate that providing a reward equal to the expected social surplus is optimal. *See id.* at 534-35.

82. *Id.* at 535 ("Under reward, there is no deadweight loss from insufficient production, whereas there is under patent.").

83. *See supra* note 77.

84. Shavell and van Ypersele explain this as follows:

> [I]f the information that the government has about demand is sufficiently good, then the reward system will dominate patent. Specifically, if the probability mass is sufficiently concentrated about $E(s^*)$, it follows . . . that reward will dominate patent. This is because the research investment under reward will tend to be superior to (and higher than) that under patent and deadweight loss from monopoly pricing will be avoided.

Shavell & van Ypersele, *supra* note 19, at 536.

85. *Id.* ("[I]f the need for well-calibrated incentives to invest in research is sufficiently attenuated, then the reward system will dominate patent, because the factor of the elimination of deadweight loss from monopoly pricing will be of dominating importance.").

most intuitive way to understand this aspect of their model is to compare a relatively simple optional reward program to patent.[86] In this simple program, the government calculates the lowest possible social surplus, i.e., the social surplus corresponding to the weakest possible demand function in the family of possible demand functions, and it offers this social surplus to the innovator in exchange for the patent. If the innovator turns down the offer, the optional reward program acts just like the patent regime, so the only cases that require analysis are those in which the innovator accepts the offer.[87] In these cases, deadweight loss is eliminated. Moreover, the reward must be greater than monopoly profits would have been; otherwise, the innovator would not have opted for the reward. As a result, the amount of investment will be greater than what would have been generated by the patent system alone, which always creates too little investment in this model. At the same time, the amount of investment will be less than or equal to the socially optimal amount of investment, because the reward offered is equal to the lowest possible social surplus. So, this relatively simple optional prize system eliminates deadweight loss and moves the amount of investment closer (though not all the way) toward the optimal amount, and it therefore must be superior to the patent system.

This simplest optional prize system is not necessarily the optimal prize system. Increasing the reward to an amount somewhat above the lowest possible social surplus will induce more innovators to accept the optional reward. An increase in the optional reward will make a difference for a particular innovator when the reward offered becomes greater than monopoly profits. As long as the reward remains lower than the actual social surplus, then the increase in the reward for that innovator was worthwhile. Indeed, it will be worthwhile as long as the reward is lower than the sum of the actual social surplus and deadweight loss saved, less any loss from more inefficient investment relative to the patent system. Awards offered past this point for a particular innovator will result in a social loss, so erring on the high side in general will have some benefits (inducing innovators to accept the award where doing so is socially beneficial) and some costs (inducing inefficient research by innovators in cases where the reward is considerably greater than the amount of monopoly profits). Shavell and van Ypersele show how to solve this optimization problem, indicating how the government could calculate the "optimal

86. *Id.* at 539.

87. *Id.* ("[T]he patent system is equivalent to an optional reward system with $r = \pi(t_o)$ [lowest possible monopoly profits], because then the patent would always be chosen.").

optional reward"[88] based on the probability distribution of demand functions in a particular case.[89] The superiority of the simple prize system to the patent system means that the optimal optional prize system is a fortiori superior.

Shavell and van Ypersele extend their model to support two additional conclusions. First, a mandatory prize system might be superior to the optional prize system, but it might not be.[90] To see why, first consider why a mandatory prize system may be better than an optional one. In an optional prize system, some innovators will choose patent rather than reward even though reward would be socially optimal. The optimal optional reward will be lower than the government's estimate of social surplus,[91] which is what the government would pay in a mandatory system, and this estimate in turn may be lower than the actual social surplus. When monopoly profits are greater than the optimal optional reward but less than the actual social surplus, the innovator would make the socially undesirable choice of patent, and if this would occur frequently enough, the mandatory prize system, by forcing the innovator to accept the reward, will be superior to an optional prize system. At the same time, we have seen that the mandatory prize system could be worse than the patent system.[92] Because the optimal optional regime is better than the patent system, in these cases the mandatory prize system would be worse than the optimal optional system.

Second, Shavell and van Ypersele show that the government could improve its performance in either the mandatory or optional prize system by basing rewards on the quantity of the relevant product sold. That is, after a patent was placed in the public domain, the government would wait to determine the quantity of goods sold in

88. *Id.* (concluding that the optimal optional reward system must be superior to the patent system).

89. Shavell and van Ypersele do not solve for the optimal reward, but they calculate the first derivative of social welfare in an optional prize system. *Id.* at 538. Setting this derivative to zero and solving for r would produce the optimal reward. The formula for the optimal reward would be messy, but a computer program easily could be written to calculate r given variables including the family of demand functions and the probability distribution of those functions.

90. *Id.* at 539.

91. Asymmetric information provides an intuitive explanation for this discrepancy. When innovators choose whether to accept the reward, some will choose the reward in part because they expect their monopoly profits to be lower than the government would have guessed. This phenomenon pushes the optimal optional reward lower than the expected social surplus. The optimization of the optional reward in effect takes into account the problem of adverse selection. *See infra* Part II.C (discussing the adverse selection problem).

92. *See supra* text accompanying note 84.

the market.[93] Observation of the quantity of goods is not by itself sufficient to deduce the innovator's demand curve; it allows for specification of one point on the demand curve.[94] Nonetheless, this information allows the government to improve its estimate of the demand curve, narrowing the family of demand curves that the government might consider in the absence of sales information. This analysis recognizes that delay allows the government better to gauge the quality of an innovation. Indeed, Shavell and van Ypersele suggest that the government could revise rewards on an annual basis, "[a]s events unfold and information flows to the government."[95] Conceivably, the government's ex post information could be even better than the innovator's ex ante information, in which case a mandatory prize system necessarily would be superior to the patent system in Shavell and van Ypersele's model.[96]

Although the Shavell and van Ypersele model elaborates and refines intuitions about different prize programs, there are several practical problems in using the Shavell and van Ypersele approach to design an actual prize system, even apart from problems to be

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93. This analysis depends on the assumption that "the government can observe quantity q sold and base rewards on this." Shavell & van Ypersele, *supra* note 19, at 540. Shavell and van Ypersele do not give any indication of whether they believe government in fact would be able to observe the quantity of goods sold, though presumably it could, with some error.

94. This conclusion assumes that the government also would be able to observe price. Shavell and van Ypersele also suggest that the government could "estimate demand elasticities, [and] undertake surveys to determine the character and frequency of use of, for example, computer software, musical recordings, cinematic and television productions." *Id.* at 541-42. Presumably, although a government agency trying to estimate demand curves could use such information, it would be more complicated to develop a formula or algorithm for determining an award based on such additional variables. Independent of this comment, which does not include explanation of how the government would use the relevant data, Shavell and van Ypersele's model may seem to reflect an assumption that the government's task must be a mechanical one, even if that means that the government must overlook relevant information. *But see infra* Part III.A (arguing that allowing the government to consider a variety of types of information not reducible to a simple formula will not be problematic if innovators have no reason to think that the government will err systematically in considering such information).

95. Shavell & van Ypersele, *supra* note 19, at 542. Shavell and van Ypersele argue that the government "could appropriately supplement rewards, perhaps on an annual basis." *Id.* This statement may reflect an assumption that the government would not be able to lower rewards by demanding that innovators give money back. If this assumption were correct, the government's optimal course would be to give initial awards based on pessimistic assessments of demand, with later supplements as the invention proved itself. Shavell and van Ypersele do not consider the possibility of having the government make a single reward determination well after the initial innovation.

96. *Id.* at 542-43. Technically, of course, Shavell and van Ypersele's model does not allow for the possibility that the government has superior information, since the innovator has perfect information about the demand function. *See supra* note 71. Their analytic point holds, though, if the knowledge of the innovator were more realistically specified.

discussed below that are general to all such attempts.[97] Shavell and van Ypersele acknowledge one caveat: that the "government's problem of determining rewards is made more difficult when the value of an innovation is in part that it leads to subsequent innovations."[98] If the government considers only sales data for a particular innovation, then it will ignore that a patent holder might have licensed the patent to someone who wished to use the innovation in a subsequent innovation.[99] There is a partial solution to this problem, if we are able to distinguish the initial innovation from subsequent innovations. The patent could be placed into the public domain for the limited purpose of allowing anyone to produce the specifically described invention, but the patent holder would retain the right to license use of the patent for subsequent innovations. This approach, however, could be cumbersome, and it reduces the benefit of placing the patent into the public domain.

Moreover, the problem is really just an example of a broader problem that Shavell and van Ypersele do not acknowledge: that an invention is not the same as a product.[100] A single product, say a computer, may be based on a variety of patents, including some held by the patent holder and some licensed from other patent holders. Similarly, one cannot assess the demand for a business method patent simply by assessing the demand for the product that the business method produces.[101] There may be some markets, such as for pharmaceuticals, in which the invention and the product are essentially the same,[102] although, as Arti Rai has pointed out in

97. *See infra* Part II.

98. Shavell & van Ypersele, *supra* note 19, at 543.

99. Shavell and van Ypersele observe that the reward system may solve some problems associated with other intellectual property systems, where "subsequent innovations may be stymied by refusal of holders of property rights to allow improvements." *Id.* Thus, this benefit may balance or offset any costs of a reward system attributable to the government's failure to account for the value of a patent for subsequent innovations.

100. *Cf.* F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697, 713 (2001) (noting, in critiquing Shavell and van Ypersele, that "existence of market demand . . . does not establish that the invention itself would have been patentable").

101. Consider, for example, Priceline.com's controversial patent on its "name your price" reverse auction system for purchasing plane tickets and other products. *See generally* Rui J. P. de Figueiredo, Jr., *Strategy, Structure and Regulation: Telecommunications in the New Economy*, 2000 L. REV. MICH. ST. U. DET. C.L. 253, 271 (discussing the patent). The relevant market is not the market for plane tickets, but how much Priceline and its competitors would be willing to pay to license the patent if someone else owned it.

102. Even in these areas, though, the innovative product might be put to a number of different uses over time, for example, as the government approves a medication for additional uses. Although a doctor can prescribe an FDA-approved drug for any use, a manufacturer can promote a drug only for approved uses. *See, e.g.*, Rhone-Poulenc Rorer Pharm., Inc. v. Marion

critiquing the Shavell–van Ypersele proposal, even in pharmaceutical markets, the existence of insurance complicates estimations of consumer surplus.[103] When inventions cannot be mapped one-to-one onto products, determining the demand for any particular invention may be extraordinarily difficult. The government would have to consider not only whether other companies would be likely to pay to license an invention, but also how much the patent holder selling a product based in part on the invention would have paid to license the patent, if the patent had been held by someone else.[104] In addition, the government might wish to assess the value of a patent in extracting settlements and licensing fees for competitors' products already incorporating the patented invention.[105] Importantly, none of this information will become clear over time, as the release of a patent into the public domain will prevent any licensing fees or settlements from being collected. We can wait to see sales of a particular computer, but that will not allow us, even with the most refined equations, to determine any better than initially the contribution of one innovation embedded in that computer.

Shavell and van Ypersele might have defended their proposal against the subsequent innovation argument and the broader argument by noting that neither affects their analytic case for the optional prize system. If government systematically undervalues patents, by failing to take into account the value of a patent with respect to licensing and the like, fewer innovators will accept the government's offers to buy out the patent. The optional prize system will still be better than the patent system—not as much better, but Shavell and van Ypersele do not quantify the benefits of adopting the

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Merrell Dow, Inc., 93 F.3d 511, 514 n.3 (8th Cir. 1996) (noting that doctors may prescribe an approved drug for any use).

103. *See* Rai, *supra* note 66, at 200. Rai explains:

> [I]n the context of pharmaceuticals, the Shavell/van Ypersele proposal has limitations. As contrasted with other goods, individuals do not generally purchase individual pharmaceuticals at the time they need them. Rather, they enroll ex ante in insurance plans that cover pharmaceuticals. These plans often do not differentiate their insurance product on the basis of the pharmaceutical products they offer. Even when plans do differentiate, it is at best a very rough differentiation (e.g., between plans with no drug coverage, plans with a closed formulary, and those with an open formulary).

Id.

104. One technique used to determine how much a company would pay for its own products is known as transfer pricing, which is used for international tax purposes. *See generally* 1-2 TRANSFER PRICING HANDBOOK (Robert Feinschreiber ed., 2001); Terry Thompson, Comment, *Canada's Transfer Pricing Laws: Keeping Pace with an International Trend*, 11 TRANSNAT'L LAW. 311, 314-18 (1998) (providing an overview).

105. *See, e.g.*, *BroadVision Settles Suit Against Art Technology*, BUS. J., Mar. 3, 2000, at 29 (reporting a settlement resulting in the payment of a licensing fee).

system anyway. As long as the government limits itself to examining observed demand for the innovation itself, whether that demand is from consumers or other producers, the system will still work when the government plugs in the variables it knows. In reality, though, this observation may mean that the Shavell–van Ypersele model is useful only, or at least mostly, for markets in which the innovation and the product are essentially the same. When a sufficiently high percentage of the value of a patent derives from something other than sales of a product uniquely associated with the patent, inventors will categorically not accept the government's offers.

There is a different answer that might be offered in defense of the Shavell–van Ypersele approach. The government could make its best effort to take all of these factors into account in calculating the social surplus created by an invention. After all, Shavell and van Ypersele never suggested that the government knows the demand function, but only that it can estimate the probability that each of a number of demand functions is in fact the demand function. Demand may be difficult to estimate, but that merely means that there will be a wide variety of possible demand functions. The government still can do its best, and optional rewards will still dominate patent. When the range of potential demand functions is wide, however, government offers in the optional prize system will have to be low to prevent innovators who know that their innovations are relatively useless from cashing in high offers.[106] But the optimal rewards may end up so low that no one with a valuable patent would accept them.

Part of the appeal of the Shavell–van Ypersele model may stem from the observation that from the beginning, the government *knows* a probability distribution of different demand functions. We are, however, given no information as to exactly how the government calculates this probability distribution, and our confidence in relying on their model as a basis for a shift in public policy ultimately rests on how well we think that the government can calculate this probability distribution. Stripped of its mathematics, the Shavell–van Ypersele model reduces to a simple argument: Providing a reward for a patent eliminates deadweight loss. While rewards could improve innovation incentives, there is a risk that rewards that deviate substantially from actual social surplus could result in innovation incentives that are too low or too high. The case for a mandatory prize system depends on how much of a distortion in innovation incentives rewards produce, if any. In principle, though, the government can make offers to buy out patents that innovators can accept or reject, setting the offers to a low

106. *See supra* note 82 and accompanying text.

enough level that overall society will benefit more than it will lose from offers that are accepted. The government is most likely to make adequate offers in areas in which an innovation and a product are essentially the same thing and the government can use sales figures to calculate demand.

That this argument is simple does not detract from its truth or from Shavell and van Ypersele's achievement in modeling it formally. It does, however, suggest that the benefit of Shavell and van Ypersele's article is not that it produces a formula that the government can use to determine rewards. After all, as noted above, Shavell and van Ypersele do not give any indication as to how to make the initial calculation of possible probability functions. If that is so, the additional insight offered by the Shavell–van Ypersele approach over, for example, the Guell and Fischbaum proposal, is modest. Its main virtue may be in showing that, at least in certain markets, well-motivated economists could use relatively standard economic techniques to determine how large rewards should be. When they do so, and properly take into account that rewards must be lower than social surplus in the optional prize system,[107] an optional prize system will be beneficial. When they are particularly good at calculating demand, a mandatory prize system will be even better.

This reduction of the model, however, identifies an additional problem, probably the most significant one, and the problem lies in the words "well-motivated." If Shavell and van Ypersele have shown that economic science provides tools that the government might use to determine appropriate rewards, that does not show that government in fact will do a good job of using those tools. One concern is that the government officials charged with the task might make various errors in calculating demand. Conceivably, a government official might produce a family of demand functions that does not even include the actual demand function. If the demand functions are all too low, then little harm done—just one more inventor sticking with the patent system.[108] But if there are a number of cases in which the demand functions are all systematically too high, the prize system could be quite expensive. The Shavell–van Ypersele optimization only works if the probability distributions are accurate.[109] If the government thinks

107. *See supra* text accompanying notes 91-92.

108. Shavell and van Ypersele note that "the fear that government would act suboptimally, and give unduly conservative rewards, would be less an issue under an optional reward scheme because innovators can always obtain intellectual property rights." Shavell & van Ypersele, *supra* note 19, at 544.

109. Conceivably, the government might recognize that the probability distributions are systematically inaccurate and mandate some transformation to convert the economists'

that a low value is one percent likely when a more competent evaluation would indicate that it is ninety percent likely, the reward program may be problematic.

The problem, however, is less likely to be the competence of the government employees than their motivations. Shavell and van Ypersele's model produces an image of objective bureaucrats doing their best, but administrative law and public choice scholars have been skeptical about this image for over fifty years.[110] Suppose, for example, that the agency were "captured" by industry.[111] It might systematically offer extraordinarily generous buyouts by starting with generous estimates of the demand function. Or, we might worry that a particular presidential administration would advance some agenda through a reward program. In a mandatory reward regime, we might worry that an administration hostile to industry interests would buy out patents at very low prices. Or, we might worry that certain industries would do well at the expense of others in a particular administration. The creation of a reward regime might in effect allow presidential control over innovation, with research flowing chaotically depending on assessments of the agenda of the particular administration or agency and shifting abruptly with transitions in power.

As with my analysis of the Guell-Fischbaum approach, I do not mean to imply that the Shavell–van Ypersele approach must be rejected. To some extent, these problems might be averted by forcing the agency to rely on proxies in calculating social surplus, for example by specifying precise procedures for calculating the family of demand functions. At least it might be possible to devise such constraints for some industries. Much work would be needed, however, to determine what these proxies should be, and there is no guarantee that Congress would create the agency with the appropriate set of constraints, even if academic agreement on them could be achieved. Perhaps there are some areas in which concerns about distorted agency incentives might be less severe, but again more work would be needed to identify those areas. In fairness, Shavell and van Ypersele recommend only "serious study of the possibility of reward systems,"[112] not adoption of a system

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probability estimates into more appropriate estimates, which presumably would entail a wider range. It is difficult, however, to determine how systematic errors in probability distributions would be identified or corrected.

110. For an early work alleging that administrative agencies might not act on behalf of an objective view of the public interest, see Samuel Huntington, *The Marasmus of the ICC: The Commission, the Railroads, and the Public Interest*, 61 YALE L.J. 467, 467-70 (1952).

111. *See generally* Merrill, *supra* note 25, at 1050-52 (discussing the rise of capture theory).

112. Shavell & van Ypersele, *supra* note 19, at 545.

that they claim to have fully specified. Nonetheless, unless one can develop a way of overcoming these problems, the Shavell–van Ypersele approach can be considered only a preliminary blueprint.

C. Kremer's Market Mechanism

Michael Kremer's proposal is similar to Shavell and van Ypersele's model in that it seeks to identify a means of objectively pricing patents so that the government can effect buyouts. Like Shavell and van Ypersele, Kremer suggests an opt-in approach rather than a mandatory reward regime. The mechanism he suggests, however, could not be more different. Instead of relying on government bureaucrats to calculate the optimal patent prize, Kremer suggests use of a market mechanism.[113] The mechanism, in simplified form, would work as follows.[114] After a patent holder decides to apply the mechanism, bids for the patent would be solicited at a sealed-bid auction, with any private party permitted to bid. The government would then offer to purchase the patent at the price determined by the auction. If the patent holder accepts the offer, the government would execute a randomization function. With some probability (say, ninety percent of the time), the patent would be placed in the public domain. The rest of the time, the high bidder would be required to purchase the patent.

The chief virtue of Kremer's proposal is that it allows the government to harness private information. Private parties will submit bids at the auction because they recognize that there is some probability (ten percent) that they will be permitted to purchase the patent. Competitors and potential competitors of the innovator may have better information than the government about the patent's

113. Kremer's proposal is but one of a number of recent proposals in a variety of legal fields to supplant existing institutions with institutions based on market mechanisms. *See* Michael Abramowicz, *The Law-and-Markets Movement*, 49 AM. U. L. REV. 327 (1999) (describing a number of recent proposals); Mark A. Cohen & Paul H. Rubin, *Private Enforcement of Public Policy*, 3 YALE J. ON REG. 167, 178 (1985) (urging the use of auctions to identify private enforcers of public policy); Jonathan Macey & Geoffrey Miller, *The Plaintiffs' Attorney's Role in Class Action and Derivative Litigation: Economic Analysis and Recommendations for Reform*, 58 U. CHI. L. REV. 1, 105-16 (1991) (recommending the use of auctions in class action and derivative litigation); A.C. Pritchard, *Auctioning Justice: Legal and Market Mechanisms for Allocating Criminal Appellate Counsel*, 34 AM. CRIM. L. REV. 1161, 1170-76 (1997) (urging that the right to serve as appellate counsel for convicted indigent defendants be auctioned, with the high bidder receiving a contingency fee if successful).

114. *See* Kremer, *supra* note 21, at 1147 & fig.I.

value.[115] As Kremer recognizes, the use of an auction is valuable not only because it gives government officials more information, but also because it constrains their discretion.[116] At least in the simplified version above, the governmental role would be minimal, limited to overseeing the auction, a task that experience suggests the government is capable of performing.[117] Even without any investigation at all, the government could rely on private parties' bids, because the private parties will be well incentivized. As in any sealed-bid auction, private parties will consider their own interests in bidding. If a private party bids too low, then it will not win the auction, making the entire effort a wasted expense; if the private party bids too much, then it may end up paying too much for the patent.

A potential limitation of the market mechanism that Kremer anticipates is that the value of a bid may be too low as a basis for a prize, because the social value of the patent may exceed the private value. Indeed, this problem animates Kremer's proposal, as he reviews a literature "suggest[ing] that social returns to innovation far exceed the private returns."[118] Rather than purchase patents at their private value, as revealed by the auction, the government could offer to purchase patents at the private value multiplied by some markup, which Kremer indicates might be between 2.5 and 3.33.[119] The government would purchase the patent at this high markup even in

115. *Id.* at 1146 ("While the value of potential inventions may be private information of the researcher before research is conducted, other firms in the industry are likely to have at least some information on the private value of the invention after inventions are patented.").

116. *Id.* at 1138 ("Allowing government officials wide discretion to set payments to inventors ex post may lead to rent-seeking and to expropriation of investors after their research costs are sunk."); *see also id.* at 1138-39 ("One problem with allowing broad administrative discretion over the patent buyout price is that this may lead to purchases at confiscatory prices, and thus reduce incentives for innovation.").

117. Government frequently holds auctions, for example to sell forfeited property. *See, e.g.*, 21 U.S.C. § 881(e)(1)(B) (2001) (providing for disposition of property in a "public sale"); *Shanxi's First Public Property Auction*, XINHUA ENG. NEWSWIRE, Dec. 11, 1997, *available at* 1997 WL 15760495 (describing a forfeiture auction in China).

118. Kremer, *supra* note 21, at 1141 (citing M. ISHAQ NADIRI, INNOVATIONS AND TECHNOLOGICAL SPILLOVERS (Nat'l Bureau of Econ. Research, Working Paper No. 4423, 1993)); MANUEL TRAJTENBERG, ECONOMIC ANALYSIS OF PRODUCT INNOVATION: THE CASE OF CT SCANNERS 11-44 (1990); *see also* Timothy F. Bresnahan, *Measuring the Spillovers from Technical Advance: Mainframe Computers in Financial Services*, 76 AM. ECON. REV. 742, 753 (1986); Edwin Mansfield et al., *Imitation Costs and Patents: An Empirical Study*, 91 ECON. J. 907 (1981); Edwin Mansfield et al., *Social and Private Rates of Return from Industrial Innovations*, 91 Q.J. ECON. 221, 234 (1977). Kremer concludes that social rates of return to research and development are generally about fifty percent, in comparison with private rates of return of about twenty-five percent. In individual circumstances, social returns may be much higher. Kremer, *supra* note 21, at 1141.

119. Kremer, *supra* note 21, at 1142.

those cases in which it sells the patent to a private party, thus ensuring the inventor the benefit of the markup in all cases, whether the patent is randomized to the public domain or not. The existence of this markup would provide a strong incentive for inventors to offer their patents to the market mechanism rather than retain their patent right and exploit it in the market.

The markup also helps solve problems associated with the "winner's curse,"[120] which refers to the tendency of winners of auctions to find that they have paid too much. First, Kremer worries that without the markup, no one would bid. After all, without a markup, if the inventor accepts a bid, it is presumably because the bid is higher than the actual value of the patent, which the inventor is likely in a better position to know than any of the bidders.[121] One solution would be to prevent the inventor from rejecting the highest offer, but this solution is not necessary given Kremer's approach. A sufficiently high markup will solve the problem, because with the government effectively subsidizing bids, bidders will recognize that an inventor might accept the offer even if the high bidder offered less than the patent value.

Second, the markup could be applied to a bid other than the highest bid to determine what the government must pay for the patent. The highest bid, after all, might be an outlier, perhaps reflecting the one firm that made a severe miscalculation in estimating the value of the patent.[122] The need for this crude system—Kremer recommends a "simple rule" in which the patent holder would be offered a "multiple of the third highest bid"[123]—is less clear than the need for a markup. Bidders, after all, have incentives to shave their bids in anticipation of the winner's curse,[124] and Kremer would make the highest bidder the winner in cases in which the government

120. *See generally* Richard H. Thaler, *The Winner's Curse*, *in* THE WINNER'S CURSE: PARADOXES AND ANOMALIES OF ECONOMIC LIFE 50-52 (1992) (characterizing the winner's curse as an example of irrational market behavior); E.C. Capen et al., *Competitive Bidding in High-Risk Situations*, 23 J. PETROLEUM TECH. 641, 643 (1971) (providing an example of the winner's curse); Kenneth Hendricks & Robert H. Porter, *An Empirical Study of an Auction with Asymmetric Information*, 78 AM. ECON. REV. 865, 882 (1988) (assessing the extent to which individuals can learn to overcome the winner's curse).

121. Kremer does not conclude that no one would bid, only that "patent owners would never sell tbeir patents" because bids would be too low. Kremer, *supra* note 21, at 1149.

122. *Id.* at 1148 & n.8.

123. *Id.* at 1148.

124. *See, e.g.*, Stuart E. Thiel, *Some Evidence on the Winner's Curse*, 78 AM. ECON. REV. 884, 884-86 (1988) (suggesting that bidders on construction contracts overcome the winner's curse by shaving their bids).

sells the patent.[125] Presumably, the purpose is to save the government from the folly of the occasional irrational bidder, but the government is relatively risk-neutral, and there is no reason to think that the highest bids will be systematically too high. The purpose may also be to ensure that the patent holder receives a relatively accurate bid. But it is not clear that some multiple of the third bid will be more likely to be accurate than the highest bid.

This last criticism may seem petty, in part because Kremer attaches little importance to using the third bid.[126] It points, however, to a broader problem. Kremer recognizes, correctly, that the highest bid in an auction may not represent *the* proper valuation of a patent. But the development of an algorithm to determine the appropriate valuation is difficult, and merely using the third-highest bid is hardly a perfect solution. The less competitive the auction, the more severe is the problem. If there are only three bidders on a patent, the third-highest bid will in fact be the low bid. It is certainly plausible that some auctions would generate very few bidders, for two reasons. First, there may be only a small number of firms ideally positioned to exploit the patent. Second, the high cost of investigation of a patent's prospects to determine the bid will discourage some bidders. In all auctions, bidders risk that their investigation costs will buy them nothing, as someone else emerges the high bidder. Wasted investigation costs are of particular concern here, given that the government often places patents in the public domain instead of selling to the high bidder.

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125. The high bidder would pay the bid of the second-highest bidder. Kremer, *supra* note 21, at 1147. This is known as a Vickrey auction, after Nobel laureate William Vickrey, who developed it. *See* William Vickrey, *Counterspeculation, Auctions, and Competitive Sealed Tenders*, 16 J. FIN. 8, 20-23 (1961); *see also* James D. Dana, Jr. & Kathryn E. Spier, *Designing a Private Industry: Government Auctions with Endogenous Market Structure*, 53 J. PUB. ECON. 127, 135-36 (1994) (discussing this auction approach); *cf.* David Lucking-Reiley, *Vickrey Auctions in Practice: From Nineteenth-Century Philately to Twenty-First-Century E-Commercc*, J. ECON. PERSPECTIVES, Summer 2000, at 183, 185 (demonstrating that Vickrey auctions were used among stamp collectors even before Vickrey was born). In such a second-price, sealed-bid auction, each competitor will bid her own valuation of the good, without shaving her bid downward in the hope of still winning the auction at a lower price.

126. Kremer states only that "it might be best for the government" to use such a rule. Kremer, *supra* note 21, at 1148. In addition, Kremer states, "If the government knew the prior distribution of valuations, it would be able to aggregate the information of all bidders to estimate the private value of tbe patent." *Id.* at 1147-48. One way to understand the intuition that the government should not simply average all bids in determining its offer to the inventor is to focus on very low bids. Someone may bid $1 on the off chance that no one else will bid, yet this $1 bid conveys very little information. More generally, some bidders may do less research than other bidders and correspondingly shave their bids by a greater amount than those other bidders because of the winner's curse. These low bids also convey relatively little information.

Imprecision, of course, is not fatal to Kremer's market scheme; even with a very small number of bidders, as long as the bidders have sufficiently strong incentives to bid accurately, we may still have more confidence in private bids than in government assessments. An additional concern, to which Kremer devotes considerable attention,[127] is the problem of collusion. A seller of a patent would have an incentive to bribe potential bidders to enter high bids. Suppose, for example, that Company *A* auctions a patent that in fact is worthless. Company *A* might promise to pay Company *B* $200,000 to bid $1,000,000 for the patent. As long as the probability that the randomization function leads to a purchase is sufficiently less than twenty percent to overcome any risk aversion by Company *B*, Company *B* should accept the offer. If, for example, the probability that the private bid will be accepted is ten percent, Company *B*'s expected payment for the worthless patent will be $100,000, and its average profit from the transaction will be $100,000. The deal also benefits *A*, which will receive $1,000,000 ninety percent of the time for a cost of just $200,000. Similar bribes, of course, might be possible with valuable patents to make them even more valuable. Once the government ignores the private bidding some percentage of the time, there will be opportunities for mutual gains from trade between patent owners and bidders.

Kremer offers several possible solutions to the collusion problem.[128] First, reliance on the third-highest bid, as described above, would make collusion more difficult by forcing a company to bribe three different bidders.[129] This provides a better argument for the third-highest-bid approach than Kremer offered earlier, but it may not be foolproof. If the three bidders cooperated, after all, relatively small bribes would be needed for the second and third bidders, since they would recognize that they would never have to pay for the patent. Second, the agency might respond to suspicions of overbidding by skipping the randomization function and forcing the high bidder to purchase the patent.[130] The problem, of course, is that the agency

127. *Id.* at 1157-62.

128. For a different solution to collusion problems with market mechanisms, see Abramowicz, *supra* note 113, at 390-93.

129. Kremer, *supra* note 21, at 1158 ("The original patent holder would therefore have to bribe three companies instead of one to ensure a substantial increase in the buyout price.").

130. *Id.* Kremer also suggests that the agency should reduce the markup when it detects collusion. *Id.* This would presumably require a costly hearing, as patent holders would argue that they had not in fact bribed bidders. While the decision to accept the high bid should be neutral to a patent holder and a bidder that have not overbid, lowering the markup or eliminating the patent holder's ability to decline to sell the patent is essentially a penalty. At the least, the government would have to provide adequate predeprivation protections to prevent such

would need to be able to identify suspicious activity, and false positives would reduce the effectiveness of the regime by reducing the number of patents ultimately placed into the public domain. Third, "[t]he government could develop lists of suspect bidders by checking whether winning bidders made money, since systematic overbidders would incur big losses."[131] Once again, this approach is perhaps sound, but also costly, time-consuming, and imperfect.

Kremer's most developed proposal for combating collusion recommends the adoption of "ceiling prices."[132] Such prices would represent the maximum that could be paid for a patent and would be determined in several complementary ways. First, "[a] waiting period of several years could be required before patents were bought by the government, and ceiling prices could be set as a multiple of annual revenues prior to the patent buyout."[133] Second, "patents could be capped by total sales of the drug following the patent buyout, times an administrative estimate of the social value of the drug per dose or per patient."[134] Interestingly, these rules make Kremer's proposal closer to Shavell and van Ypersele's, with the attendant strengths and limitations of that approach. The government would monitor sales, both before and after the patent buyout, while at the same time using some method to extrapolate the social value of the drug. The proposals, of course, are not identical. Shavell and van Ypersele would use such data to calculate a relatively low offer for the patent holder,[135] while Kremer would use sales data as a cap on market price.

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penalties from being applied inappropriately. *See generally* Matthews v. Eldridge, 424 U.S. 319, 335 (1976) (providing a three-part test for determining whether a governmental procedure violates the due process of law).

131. Kremer, *supra* note 21, at 1158.

132. *Id.* at 1159-62.

133. *Id.* at 1159.

134. *Id.* at 1160. Kremer also offers a third, slightly more elaborate proposal. *Id.* at 1160-61. Under this proposal, inventors would be paid *only* if the randomization function led the patent to be sold to the high bidder. *Id.* at 1160. In this case, the inventor would receive an amount equal to the monopoly profits earned by the high bidder, multiplied by the inverse of the probability that the patent would be sold to the high bidder. *Id.* at 1160-61. This proposal has two limitations. First, there would be a substantial risk that the patent holder would receive nothing. Presumably, a patent holder might try to insure against this risk, but the insurance could be expensive. Second, and more significantly, there would still be an incentive to manipulate the system ex post. Kremer notes that one might do so by "bribing the high bidder to boost sales artificially through tie-ins with other products." *Id.* at 1161. More generally, any falsification of sales figures would be profitable. Alternatively, the original patent holder might just buy lots of the product (or pay third parties to do so), especially if the probability of the patent being randomized to the high bidder is sufficiently low (and thus the inverse sufficiently high). Once again, the government could try to protect against these schemes, but it may not do so successfully.

135. *See supra* text accompanying notes 91-92.

Nonetheless, the more government must make discretionary decisions, the less attractive Kremer's market mechanism becomes.

Perhaps the government could be successful in combating explicit collusion, either through one of Kremer's approaches or through some other approach, such as rigorous criminal enforcement of a ban on such collusion and bounties for private parties who expose collusive behavior.[136] Nonetheless, even if the government can eliminate all explicit collusion between patent holders and bidders, it still might face the problem of implicit collusion.[137] Consider two drug companies. One company might offer a large bid for the other company's patent in the hope that the other company will reciprocate, and if the companies are repeat players, they might start offering generous bids on each other's patents without even communicating directly with each other.[138] Again, the government might be successful in identifying such behavior, but it would be especially difficult to police on the margins, where the companies' bids are high but not absurdly so. The government might combat collusion, either implicit or explicit, by reducing markup prices accordingly,[139] but this adjustment is a crude solution that will lead some markups to be too high and some markups to be too low.

Kremer does not recognize the possibility of this form of implicit collusion, but he does recognize another form. A company might make a routine practice of buying back its patents from the high bidders at a generous price. This strategy would work only for a frequent player, especially if relatively few patents are randomized to the high bidder rather than to the public domain. A company that acquires such a reputation, however, would receive high benefits and thus benefit in all the cases in which the patent is randomized to the public domain. Kremer's solution is that "inventors would be

136. For a related proposal in the antitrust context, see William E. Kovacic, *Antitrust Policy and Horizontal Collusion in the 21st Century*, 9 LOY. CONSUMER L. REP. 97 (1997).

137. Implicit, or tacit, collusion presents a substantial challenge to antitrust lawyers. *See* Michael Freed et al., *The Detection and Punishment of Tacit Collusion*, 9 LOY. CONSUMER L. REP. 151 (1997) (reporting a conference on the problem of implicit collusion).

138. The challenge is for the parties to solve the prisoners' dilemma, as each of the two companies would benefit most by having the other company help it without itself providing help to the other company. *See* DOUGLAS G. BAIRD ET AL., GAME THEORY AND THE LAW 31-35 (1994) (providing an introduction to the prisoners' dilemma). Here, the prisoners' dilemma would occur over multiple rounds, making it potentially tractable. *See* David M. Kreps et al., *Rational Cooperation in the Finitely Repeated Prisoners' Dilemma*, 27 J. ECON. THEORY 245 (1982) (providing a model leading to cooperation in finite-period prisoners' dilemmas).

139. *See* Kremer, *supra* note 21, at 1162 ("For example, if the optimal markup was three (as seems plausible), and if collusion were thought to raise prices by up to 50 percent, then the government could simply offer a markup of two.").

prohibited from buying back the patent from the winning bidder."[140] The government might be able to enforce this successfully, but it does have costs. As Kremer recognizes elsewhere in his article, the original patent holder may be the lowest-cost producer,[141] so the proposal would mean that when patents are randomized to the high bidder, it will be owned not just by a monopolist but by an inefficient monopolist. The cost of such inefficiency might be reduced by lowering the probability that the patent is randomized to the high bidder, but this solution will decrease the number of bidders and increase the risk of collusion.

Collusion is not the only potential problem for Kremer's system. Just as Shavell and van Ypersele's model worked best when each innovation corresponded to a single product,[142] so too Kremer's proposal works most smoothly when the sales of each invention are independent of the sales of all other innovations. When one product is a substitute or a complement of another, incentives will be distorted. As an example of the complication that arises from substitutes,[143] Kremer explains that "people would bid less for the patent on Prozac if they expected that the patent on Zoloft would be put in the public domain."[144] That is, the Zoloft patent will be worth less because of the possibility that Prozac will end up in the public domain, and the reverse is true as well. If Prozac and Zoloft are perfect substitutes and can be manufactured for zero marginal cost, then the value of each in the auction will be discounted by the probability that the other will be placed in the public domain. Thus, if there were a ninety percent chance of placement in the public domain for each of the drugs by the market mechanism, then each would fetch only ten percent as much as if the other drug did not exist.

Complementary products present the opposite problem. Suppose that a new drug cocktail for a disease consists of two independently patented drugs, Drug *A* and Drug *B*, which again can be produced for zero marginal costs. *A* and *B* are perfect complements,[145] so that a pill of *A* is worthless without a pill of *B* and vice versa. If these complements are auctioned independently, the

140. *Id.* at 1159.

141. *Id.* at 1150-52.

142. *See supra* text accompanying notes 101-05.

143. Economists define products as substitutes if they are "related such that an increase in the price of one will increase the demand for the other or a decrease in the price of one will decrease the demand for the other." EKELUND & TOLLISON, *supra* note 30, at G-20.

144. Kremer, *supra* note 21, at 1154.

145. Complements are "[p]roducts that are related such that an increase in the price of one will decrease the demand for the other or a decrease in the price of one will increase the demand for the other." EKELUND & TOLLISON, *supra* note 30, at G-4.

private bids for the two independently will be greater than the value of the two together. A bidder for the *A* patent will reason, using the same probability for randomization as before, that there is a ninety percent chance that *B* will be placed in the public domain. Thus, if *A* is randomized to a bidder, there is a ninety percent chance that the owner will be able to extract the full monopoly profits for the combined cocktail. There is just a ten percent chance that the owner will have to enter into some arrangement with the new owner of the *B* patent and thus receive only about half of the monopoly profits.[146] Thus, the bidder on patent *A*, if risk-neutral, will bid ninety-five percent of the value of the monopoly profits of the two drugs combined. Using precisely the same reasoning, the bidder on patent *B* will do the same. If both are randomized to the public domain, the government will pay 1.9 times monopoly profits, even before the markup. And the problem, of course, will be more severe with a three-drug cocktail.

Kremer offers a neat solution to the substitute and complement problems, but the solution is an imperfect one. The trick is to jointly randomize groups of such patents,[147] so that either all are placed in the public domain or all are randomized to private bidders. Doing this coordinated randomization would solve the problem, since the distortions above arise only when one innovation is placed in the public domain while the other is not. The difficulty is that the government must identify substitutes and complements. Substitutes are easier,[148] since holders of substitute patents would have every incentive to present their patents for joint randomization, and, as Kremer points out, joint randomization of patents that are not really substitutes would do no harm.[149] The challenge, however, would be

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146. Kremer gives a similar example, though in his example, the patents are auctioned at different times:

> [C]onsider an example in which two complementary inventions each have private value 0.1π individually but have value π together, and suppose that the social value of the patents alone or together is twice their private value. If one patent is put in the public domain, then the reward for invention of the other patent will be 0.9π times the markup. This implies that under separate patent buyouts the developers of *each* patent can expect to receive approximately 0.9π times the markup, since bidders for the first patent will anticipate that the second patent is likely to be put in the public domain and by the time the second patent has been invented, the first patent will probably be in the public domain. This will create excessive incentives for creation of the pair of inventions, since the social value of the pair is only 2π.

Kremer, *supra* note 21, at 1156.

147. *See id.* at 1154-55 (proposing joint randomization for substitute patents); *id.* at 1155-57 (proposing joint randomization for complementary patents).

148. Professor Rai, however, notes, that in the pharmaceutical market, "[g]iven the pervasiveness of me-too pharmaceuticals . . . Kremer's proposed regime would effectively result in mandatory buyouts for many innovator patents." Rai, *supra* note 66, at 201.

149. There is, however, a problem that Kremer does not recognize. Kremer explains:

greater for complementary patents, since companies would have no incentive to come forward.[150] Kremer suggests that the government would be able to identify "very strong complements."[151] The approach, however, would require bureaucrats at least to recognize that a patent might be complementary to another,[152] and the method might not work for weaker complements.

The market mechanism's susceptibility to gaming, either through collusion or in the case of complementary patents, does not necessarily rule it out as a useful method for valuing patents. It is especially useful when other methods for valuing patents, such as those described in the preceding sections, would be ineffective. For example, when a patent holder would obtain value from the patent primarily by licensing it to other companies that would incorporate the patent into their own inventions, the market mechanism provides

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> Note that joint randomization does not require a bureaucracy to judge whether goods are substitutes. Any patent holder could claim that his or her patent was a substitute for a new patent, and request that it be jointly randomized with the new patent. Even if the new patent was not in fact a substitute for the old patent, jointly randomizing the old patent together with an unrelated new patent would create no harm and would have the advantage of possibly transferring another patent to the public domain.

Kremer, *supra* note 21, at 1155. The problem is that once a patent is randomized to a bidder, the bidder should not be able to place the patent through the system again. The reason is that bidders in the initial auction would anticipate being able to place the patent back up for auction and receive the markup. Suppose, for example, that the monopoly profits for an innovation will be $1 million and the markup is two. In Kremer's system, if the patent is randomized to the high bidder, then the high bidder will pay the amount of the second highest bid and receive the patent; the original patent owner, meanwhile, will receive the benefit of the markup. But if the high bidder could then reauction the patent and receive the markup, then the initial bid would be around $2 million rather than $1 million. Indeed, it would be higher, since the bidder would anticipate that the bidder in the next round would anticipate being able to reauction the patent, and so on ad infinitum. Happily, the problem is not a fatal one. The solution is simply to eliminate the markup for patents that are reauctioned. As this example reveals, however, the Kremer system cannot be relied on to place virtually all patents in the public domain, since the patents that are randomized to bidders will likely stay with bidders, rather than being repeatedly auctioned until being placed in the public domain. The example also shows that it may be difficult to anticipate all possible ways that a particular approach might be exploited.

150. Indeed, a company would seek to market different components of the same product separately if multiple patents could be obtained. *See id.* ("It would also create an incentive for inventors to divide up inventions into multiple complementary patents.").

151. *Id.* at 1157.

152. Kremer explains that "[i]f a set of patents are complements, the sum of the bids for subsets will be less tban the bids for the entire set." *Id.* The government thus must have sufficient suspicions of complementarity to allow bidding on a set of patents in addition to bidding on the individual members of the group. If patents are being auctioned at the same time, the government might allow bidders to bid on any combination of patents, resulting in joint randomization if the bid on whatever combination a bidder chooses is higher than the highest bids for the patents individually. This market solution, however, will not work, at least without substantial elaboration, when patents are auctioned at different times—which inventors of complementary patents accordingly would have an incentive to do.

a useful means of obtaining an objective valuation. Nonetheless, the mechanism does not eliminate the need for human supervision, either in the form of a bureaucracy or through some sort of litigation, to identify instances in which gaming of the system might lead to inaccurate results. At the same time, the mechanism will be less useful when it is imperative to transfer a particular patent to the public domain with complete certainty or when the existence of complementary patents complicates the valuation process.

D. Lichtman's Coupon Scheme

Douglas Lichtman's proposal in *Pricing Prozac* differs from those of the other three authors in that he does not suggest buying out patents.[153] Indeed, Lichtman's article begins by discussing Kremer's proposal, and while complimentary of it,[154] Lichtman suggests that deadweight loss might be eliminated far more cheaply.[155] Under Kremer's proposal and the others discussed so far, the government would buy out the patent, thus paying in an opt-in regime at least the monopoly profits that the patent holder would have expected to receive. Lichtman argues that a full buyout is not necessary to eliminate deadweight loss. Instead, Lichtman suggests that the government subsidize the purchase of patented products such as pharmaceuticals. In essence, the government would give discount coupons to the consumers who would be willing to pay more than marginal cost for the drugs but would not be willing to pay the monopoly price. Astonishingly, Lichtman demonstrates that, under certain stylized assumptions, a well-executed program might cost only one-eighth as much as a patent buyout.[156]

Before arguing that patent buyouts nonetheless might be superior to coupon schemes in some circumstances, I will trace Lichtman's argument. First, however, it may be worthwhile to identify a principle that provides an intuitive basis for why a coupon scheme can eliminate deadweight loss. It is a familiar concept from introductory microeconomics courses that there will be no deadweight loss from a monopoly if the monopolist can perfectly price

153. *See* Lichtman, *supra* note 22.

154. *See id.* at 124 ("The proposal has much to recommend it. Unlike more conventional approaches, Kremer's suggestion balances the twin goals of encouraging private research and increasing the availability of new pharmaceuticals." (footnote omitted)).

155. For Lichtman, the purpose of limiting the government's expense is to limit the deadweight loss associated with the distortionary effects of taxation. *See id.* at 124, 136; *infra* Part II.D.1 (discussing the distortionary effects of taxation).

156. Lichtman, *supra* note 22, at 135.

discriminate.[157] A monopolist who price discriminates charges each consumer who values the product at more than its marginal cost the maximum that this consumer will pay for the product. Even the consumer who values the product at just one cent above marginal cost is worth selling to if the sale does not affect the price paid by the other consumers. Perfect price discrimination eliminates consumer surplus, but it eliminates deadweight loss too.[158] Just as a monopolist that can perfectly price discriminate eliminates deadweight loss, the government might use coupons to eliminate deadweight loss even if a monopolist charges the same price to everyone.

Some consumers, of course, will be willing to purchase the product at the monopoly price, but some will not. For consumers who place some value on the product but not so much as to buy it at the monopoly price, a coupon can make the difference. For example, if the price of a drug is $5 and a consumer values it at $4, then the consumer will be willing to purchase the drug with a $1 coupon. If the government can give each consumer who values the drug at between marginal cost and the monopoly price just the right size coupon, then the government will have eliminated deadweight loss relatively cheaply. "Give him just one dollar," Lichtman explains, "and you will, in effect, be increasing the producer's revenue by five dollars."[159] Moreover, the government might get by with an even smaller coupon, if it can induce the monopolist to lower its price to capture additional consumers. For example, if a number of consumers valuing the drug at $4 had $0.75 coupons, the monopolist might lower the price to $4.75 rather than lose these customers altogether, benefiting both these consumers and others. In contrast, a buyout would require the government in effect to spend the full $5 to provide the consumer surplus in the example above.

The government's ability to reduce deadweight loss and induce the manufacturer to lower price is contingent on its ability to determine the size of coupons that individual consumers should receive. Moreover, Kremer argues in a footnote rejoinder to Lichtman,[160] the government must have *better* information than the

157. *See, e.g.*, NICHOLSON, *supra* note 76, at 574.

158. In addition, because the monopolist will capture the full social benefit of the invention, the monopolist has the proper incentive to invest the appropriate amount in an innovation. *See supra* note 77 and accompanying text. *But see infra* text accompanying notes 256-59 (arguing that patents might promote excessive incentives to innovate).

159. Lichtman, *supra* note 22, at 125.

160. Kremer, *supra* note 21, at 1139 n.1 (stating that targeting subsidies "requires that the government have lots of information"). Kremer is able to respond to Lichtman because Lichtman's article was a response to an early version of Kremer's article. *See* MICHAEL KREMER,

monopolist. After all, if the monopolist knew how much each consumer valued the product, it presumably would be perfectly price discriminating itself, saving the government the trouble. Lichtman anticipates this argument in two ways. First, he suggests in a footnote that the government might be better positioned to give coupons than a monopolist would be to price discriminate. "Clues that are available to the government (tax returns, voluntary disclosures made for the purpose of qualifying for health and welfare programs, etc.) are, for good reason, not available more broadly."[161] In addition, "even where price discrimination is practical, such behavior is sharply restricted under both antitrust and patent misuse doctrine."[162] Second, Lichtman falls back on the conclusion that a well-executed scheme would cost only one-eighth as much as a patent buyout. "[S]o long as one in every eight dollars is placed in the hands of an appropriate consumer, the consumer subsidy scheme will be the most effective option."[163]

The first of Lichtman's claims is difficult to assess without a detailed empirical analysis. On the one hand, the government might have access to some data that a company either does not have access to or cannot take advantage of, but it is also true that the company may be able to price discriminate in ways that the government cannot. This observation, however, does not undercut Lichtman's proposal. A company's price discrimination and the government's distribution of coupons can be complementary, with the first eliminating some deadweight loss and the second eliminating some more or perhaps even all deadweight loss. Indeed, the existence of some price discrimination by patent holders strengthens Lichtman's argument by

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PATENT BUY-OUTS: A MECHANISM FOR ENCOURAGING INNOVATION (Nat'l Bureau of Econ. Research, Working Paper No. 6304, 1997).

161. Lichtman, *supra* note 22, at 133 n.25.

162. *Id. But see* Kieff, *supra* note 100, at 727-32 (arguing that patent holders often reduce deadweight loss through price discrimination). Lichtman's allusion to antitrust is presumably a reference to the Robinson-Patman Act, 15 U.S.C. § 13(a) (1994), which makes it "unlawful for any person engaged in commerce . . . to discriminate in price between different purchasers of commodities of like grade and quality." Enforcement of the Act, however, has long been on the decline, in part because of the recognition that price discrimination may promote efficiency. *See* Rudolph J. Peritz, *The Predicament of Antitrust Jurisprudence: Economics and the Monopolization of Price Discrimination Argument*, 1984 DUKE L.J. 1205, 1210-11 (1984); *see also* Brooke Group Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209, 229-30 (1993) (requiring proof of generalized injury to competition in certain types of price discrimination cases). It is true, meanwhile, that some courts have found patent misuse based on price discrimination even in the absence of a finding of an antitrust violation. *See, e.g.*, Motorola, Inc. v. Kimball Int'l, Inc., 601 F. Supp. 62, 65 (N.D. Ill. 1984). The Federal Circuit, however, sharply limited the doctrine of patent misuse in *Mallinckrodt, Inc. v. Medipart, Inc.*, 976 F.2d 700, 708 (Fed. Cir. 1992), by holding that use restrictions beyond the scope of a patent grant would be evaluated under antitrust law's rule-of-reason analysis.

163. Lichtman, *supra* note 22, at 136.

leaving the government with less to do on its own. Suppose a company can effect perfect price discrimination with a representative half of its consumers and cannot price discriminate at all with the other consumers. Then, a well-executed scheme to eliminate deadweight loss should cost only half as much as before, or one-sixteenth as much as the cost of a patent buyout if the government has perfect information about consumers' price preferences. And even if the government does not have perfect information, Lichtman's logic suggests that as long as one of every sixteen dollars is placed in the hands of a consumer who needs it, the scheme will be as cheap as a patent buyout.

Surely Lichtman is right that a one-in-eight "ratio seems exceedingly achievable" for pharmaceuticals,[164] and a one-in-sixteen ratio even more so. Thus, the strength of Lichtman's proposal ultimately depends on his second fallback argument. Lichtman is indeed correct under his stated assumption that if the government has perfect information, then, ignoring administrative costs,[165] a coupon scheme will be one-eighth the price of a buyout scheme. I will argue, however, against his intuitively appealing inference that the coupon scheme must be judged as successful as a buyout scheme if only one in eight dollars is placed in proper hands. This inference would be correct if the incorrectly allocated dollars are used on other products altogether—groceries or movie tickets, for example. Such misuse, though, is presumably easy to prevent with coupons.[166] But it is not correct if the government awards coupons to people who will use them to purchase the drugs but who are not the people who would have received the coupons had the government executed the scheme perfectly. When someone who would purchase the product anyway receives a coupon, Lichtman's conclusion is incorrect. To justify this fully, I will need to fill in more of Lichtman's argument and explain how Lichtman calculates the one-eighth figure.

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164. *Id.*

165. *See infra* Part II.D.2.

166. In defending the proposition that the "opportunity for abuse is small," Lichtman argues that "[t]his would be especially true if subsidies were ultimately implemented in a very precise manner—a $5 non-transferable coupon given to consumer *A*, usable only toward this month's purchase of Prozac." Lichtman, *supra* note 22, at 136. I agree that we probably need not worry too much about the possibility that *A* will get around this limitation by, say, falsifying a receipt for Prozac. A greater concern might be that *A* would sell the receipt to someone who does not need it or that pharmacies might facilitate fraud, similar to current problems with food stamps. *Cf.* FOOD & CONSUMER SERV., U.S. DEPT. OF AGRIC., THE EXTENT OF TRAFFICKING IN THE FOOD STAMP PROGRAM (1995) (discussing the black market in the food stamp program). I will assume, however, that even this type of abuse could be addressed.

To understand Lichtman's calculation, consider Figure 2, which includes two panels nearly identical to figures in Lichtman's article.[167] Both panels assume a linear demand function and zero marginal cost of production.[168] Under these circumstances, a monopolist who can set only a single price will sell to half of all consumers who assign some value to the product,[169] because doing so maximizes monopoly profits, the shaded area in the left panel. Such a monopolist would be equally well off if it could sell its product to all the consumers at half the monopoly price, as indicated in the right panel. The problem, of course, is that this point is above the demand curve. In the absence of government intervention, at that price, only three-quarters of consumers would buy the product.[170]

167. *See* Lichtman, *supra* note 22, at 131 fig.1, 135 fig.4.

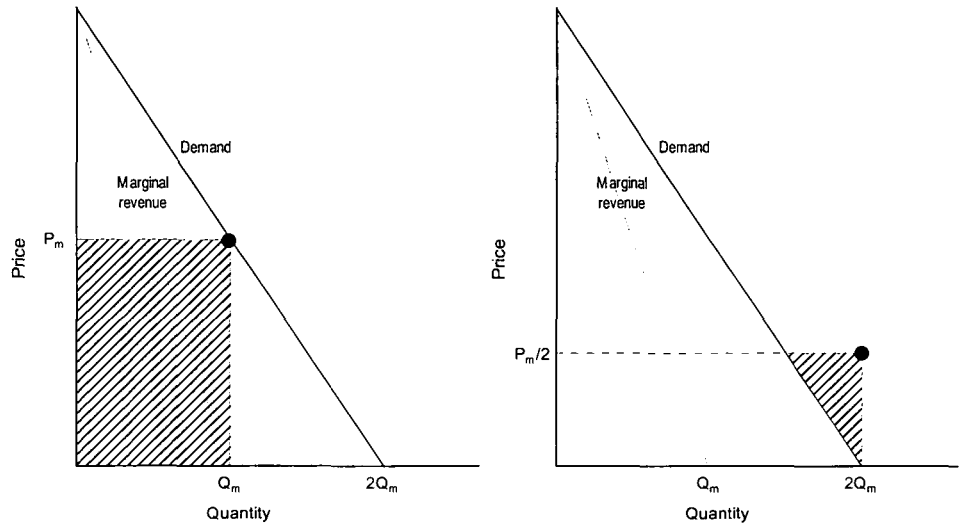
168. *Id.* at 130.

169. *Id.* at 132 n.21 ("When facing linear demand and zero marginal cost, a monopolist maximizes profit by selling to exactly half the consumers.") (citing PAUL A. SAMUELSON & WILLIAM D. NORDHAUS, ECONOMICS 583 (13th ed. 1989)). Lichtman's figures, unfortunately, are not drawn to scale, making it appear that the monopolist would he selling to more than half of all consumers. l have tried to correct this problem in the diagram above.

170. This follows from the assumption of linear demand. If at the monopoly price half of all consumers would buy the product, and all of the consumers would take the product if it were free, then at half the monopoly price, three-quarters of consumers will buy the product.

Figure 2: The Coupon Alternative to Patent Buyouts

As in Figure 1, a profit-maximizing patent holder will choose the monopoly price P_m and quantity Q_m in the absence of a buyout program or coupon scheme. Because marginal cost is assumed to be zero, the shaded area in the left panel represents the patent holder's profits. This is the minimum amount that the government would have to pay the patent holder to buy out the patent and leave the patent holder just as well off as with the patent system. In the absence of a buyout, the patent holder could make equal profits by selling at half the monopoly price to twice the number of consumers. The point representing this combination, however, is above the demand curve, because the lowest-valuing quarter of consumers does not value the patent at even this much. By providing just a large enough coupon to each of these consumers, the government in effect fleshes out the demand curve. The shaded area in the right panel is the cost of this program, and is one-eighth the size of the shaded area in the left panel.



The government's task then is simply to give coupons to the remaining quarter of consumers (which is equal to half the number of consumers who would be served by the monopolist). Moreover, the government does not have to give a full coupon, equal to half the monopoly price, to every one of these consumers. If the government has perfect information, then it can give some consumers just a penny coupon, so that the average coupon needed amounts to just one-half of one-half of the monopoly price. Paying an average of one-fourth of the monopoly price to one-half of the consumers who would be served by a monopolist is equivalent to paying one-eighth of monopoly profits. Indeed, the subsidy triangle in the right-hand panel is one-eighth the size of the producer's surplus box in the left hand panel.

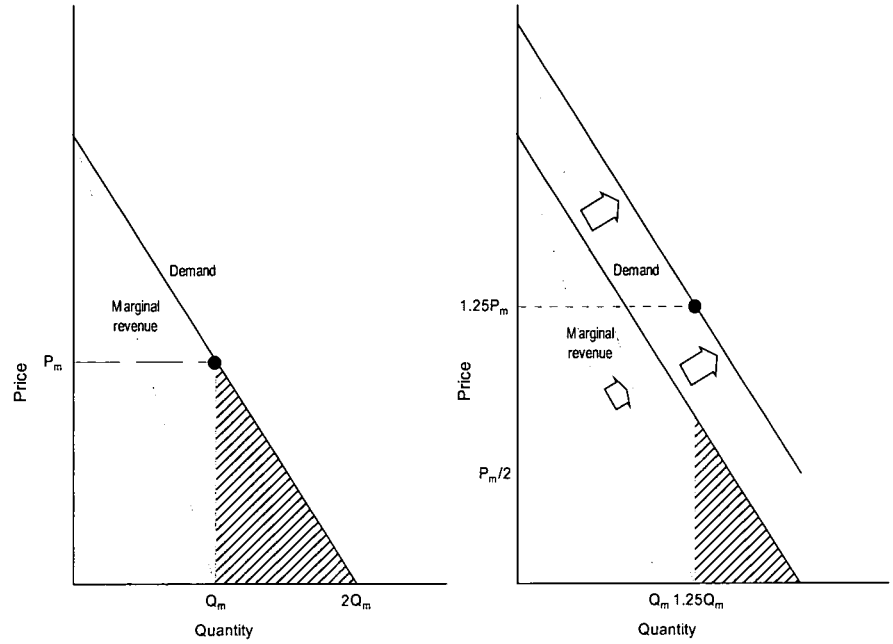
Lichtman's reasoning on this point is sound. To assess the limitations on this observation, however, begin by considering what the monopolist would do if the government were able to effect its

perfect coupon scheme. Assuming with Lichtman that the monopolist must set a single price, the monopolist should be indifferent between selling at the monopoly price and selling at the lower price that, with the coupons, will produce an identical profit. Thus, even if the government issues the coupons to the proper consumer, the monopolist could still choose the monopoly price. Presumably, the monopolist would not do so for reputational reasons, though the monopolist might if the government is not able to give all of the last quarter of consumers coupons. As soon as a single consumer who needs a coupon does not receive one, the monopolist will be better off selling at the monopoly price.

This example, however, reveals two things. First, the government cannot ensure cooperation from monopolists in pricing their drugs if they fail to execute the coupon scheme perfectly. Second, it is important for the government to ensure that all consumers who should qualify for coupons do in fact receive such coupons. In the absence of perfect information, however, a government intent on accomplishing this objective is likely to give coupons to some people who should not receive the coupons, and indeed it may become necessary to give coupons to all consumers. This allocation in turn will lead monopolists not to cooperate in pricing. When relatively high-valuing consumers receive coupons, the monopolist is less likely to set the price to the lower value. Indeed, giving coupons to consumers who would have purchased the drug anyway may lead the monopolist to raise the price.

Figure 3: The Effect of a Universal Coupon Scheme

Providing coupons to all consumers shifts out the demand curve from the patent holder's perspective. The patent holder will respond by serving twenty-five percent more consumers at a price twenty-five percent higher than in the monopoly case. The deadweight loss triangle, shaded in both panels, is reduced from half the monopoly profits in the standard monopoly case to 9/32, a reduction of just forty-three percent.



To see why the monopolist might raise its price in response to the award of coupons, consider the case in which the government gives all consumers of a particular drug a full coupon, that is the amount that would be needed to induce the consumer who least values the drug (but still values it more than zero, the marginal cost) to purchase it in a perfectly executed subsidy scheme. This is, of course, the only way that the monopolist can ensure that all of the consumers in the last quartile receive coupons. The government's generosity effectively shifts out the demand curve, as illustrated in Figure 3. A profit-maximizing monopolist will respond by raising the price and, even with the shifted out demand curve, serving only a few more consumers than before. The monopoly profits will be greater than previously, but the government will not have accomplished its aim. Many consumers will still not use their coupons because the coupon is insufficient to allow them to meet the higher price, and the deadweight loss will be reduced only somewhat.

This example shows the fallacy in Lichtman's inference that the government can misspend seven dollars for every dollar it spends correctly and still achieve the same benefit that a patent buyout program would bring. Here, the government misspends seven dollars for every dollar that it spends correctly (including the excess from granting full rather than partial coupons to the lowest-valuing quarter of consumers), and much of the benefit of the program is lost. This flaw is not fatal,[171] as the government might award coupons only to those consumers it believes to be in the bottom quartile and compensate by paying the monopolist a bonus for every coupon cashed. Thus, the government might pay the company $2 for a coupon worth $1 to induce the company to price its product at the low level where coupons will make an impact. As long as the government gives low-valuing consumers coupons with sufficient producer bonuses to make up dollar-for-dollar revenue lost from low-valuing consumers who do not receive the coupons, the patent holder will choose the lower price rather than the monopoly price.

Similarly, the government could increase the redemption value of just some coupons, those that will go to consumers who the government is most confident are in the last quarter of consumers. To what extent must the government increase the producer's redemption value of such coupons to make up for relatively high-valuing consumers who mistakenly receive coupons? The theoretical analysis is complex. Giving a coupon to a consumer will have no effect on the monopoly price if the amount that the patent holder would have to raise the price to increase its revenues from this consumer is less than the amount that the patent holder would lose from decreased output.[172] On the other hand, giving a coupon to some consumers may require the government to make up for this coupon more than dollar for dollar.[173] A further complication is that the amount that the

171. The observation does, however, pose a problem with Lichtman's argument that the government might choose "to pursue a mixed strategy, allowing some of the deadweight loss to remain but eliminating the remainder by means of a consumer subsidy." Lichtman, *supra* note 22, at 138. While it is possible for the government to eliminate just some deadweight loss, distributing only a few coupons without using the "bonus" approach suggested above is unlikely to induce the monopolist to lower its price.

172. For example, awarding coupons of up to the difference between the monopoly price and the desired low price to only the very highest-valuing consumers, those in the first quartile, would have no effect on the monopoly price or producer welfare at all. Raising the monopoly price by up to that amount would not affect the amount that these high-valuing consumers will end up paying and would cause the patent holder to lose revenue from the second quartile. The only effect would be distributional.

173. Take, for example, the consumer who values the product at one penny less than the monopoly price. If that consumer is given a one-penny coupon, then the consumer will buy at the monopoly price. Thus, the monopolist's profits from selling at the monopoly price instead of at

government must make up for giving one coupon erroneously may depend on to whom else the government has erroneously awarded coupons. This makes it difficult to develop a simple formula for how much the government will have to provide in coupon bonuses for the producer to compensate for imperfections in the government's calculations.

To generate at least tentative calculations, I designed and executed a computerized simulation. The simulation featured five thousand consumers whose valuations ranged linearly from $0 to $1.00. The simulated government was able to estimate the maximum amount that each consumer would pay for the product with some error. The simulation calculated the government's estimates by adding to each consumer a stochastic error term with a specified variance. For every consumer that the government estimated would be willing to pay less than $0.25—that is, for consumers that appeared to the government to be in the bottom quartile—the government granted a coupon equal to the amount that the government estimated would be necessary to induce the consumer to purchase the product at $0.25.[174] (Recall that $0.25 would be the price at which the government would seek to induce pricing in Lichtman's model to eliminate all deadweight loss if coupons are allocated correctly.) Thus, if the government estimated that a consumer would be willing to pay $0.05, the consumer would receive a $0.20 coupon.[175] In addition, for consumers whose willingness to pay the government estimated at less than $0.125, the government added a producer's bonus to the coupon. The producer's bonus would not change the price to the consumer but would result in a government payment to the patent holder at the specified price.

Table 1 shows the results of the simulation.[176] The first column shows different values for the variance of the error term; lower variance means the government has a greater ability to estimate

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the lower price will rise by the full amount of the monopoly price. To make the lower price attractive, the government will have to make up for the full amount of the monopoly price.

174. I also ran simulations in which the government gave all consumers in the bottom quartile slightly more than the government estimated would be necessary. This approach proved to be less cost effective than giving consumers exactly what it appeared they needed.

175. Because of the stochastic error term, the simulated government estimated the maximum that some consumers would pay as a negative number. For these consumers, the government granted a $0.25 coupon. Presumably, consumers who in fact have negative reservation prices would not take the product even for free, so giving $0.25 coupons to all consumers who seem to have such negative reservation prices would be an appropriate policy. Consumers who really do not want the product presumably would throw the coupons out (assuming away the risk of arbitrage, *see supra* note 166), and consumers whom the government has misplaced in this category would be able to use the coupons.

176. The computer file containing the simulation is available on request from the author.

consumers' willingness to pay. The second column indicates, for that variance, the minimum producer's bonus needed in the simulation for it to be more profitable for the patent holder to price the product at $0.25 rather than at $0.50. The third column indicates the total cost to the government of redeeming the coupons and paying bonuses to the patent holder at that level, as a percentage of how much it would cost the government to effect a buyout by paying the original monopoly price. The fourth column indicates the total cost to the government as a percentage of deadweight loss eliminated, taking into account that some consumers who value the product above marginal cost still will not purchase the product with the coupon provided by the government. Note that because the government expenditures are transfers and reductions of deadweight loss are efficiency gains, a coupon program would still advance social welfare relative to the status quo beyond one hundred percent. Finally, the fifth column reports the relative cost efficiency of coupons and a perfectly executed buyout scheme. For example, a cost efficiency of 0.50 would indicate that $0.50 spent on a coupon scheme with the specified degree of error would eliminate as much deadweight loss as a dollar spent on such a buyout scheme.

Thus, the first row shows that if the government can estimate individual consumers' demand perfectly, then it need pay only a penny in producer's bonus to induce pricing at 0.25 rather than 0.50, and the total cost of the coupons to the government as a percentage of the original monopoly profit is thirteen percent. Note that this is one-in-eight dollars, just as Lichtman's model predicts.[177] For higher variances, the government's total cost grows, with the cost efficiency of subsidies exceeding the cost efficiency of a patent buyout when the variance reaches approximately 0.26. (Recall that with linear demand, the cost of a buyout is the monopoly profit, which is twice deadweight loss, so buyouts and coupons are equally effective when the total costs to the government of a coupon scheme as a percentage of deadweight loss is two hundred percent.)

177. The percentage will be exactly 12.5% if the government does not pay any producer's bonus. As indicated above, however, this would leave the monopolist indifferent between pricing at $0.25 and $0.50. *See supra* text preceding note 171.

Table 1: Simulation of Coupon Program Effectiveness Based on Quality of Government Information

Variance of Error Term (in Dollars)	Minimum Producer's Bonus Needed (in Dollars)	Total Cost to Government as Percentage of Cost of Buyout	Total Cost to Government as Percentage of Deadweight Loss Eliminated	Cost Efficiency of Coupons Relative to Buyouts
0	0.01	13%	26%	0.13
0.01	0.35	24%	54%	0.27
0.1	0.49	57%	130%	0.65
0.2	0.56	77%	177%	0.89
0.25	0.59	86%	197%	0.98
0.3	0.60	92%	211%	1.06
0.4	0.63	103%	235%	1.18
0.5	0.64	110%	252%	1.26

This simulation analysis thus indicates that when the government has sufficiently good information for distinguishing high-valuing from low-valuing consumers, subsidies are indeed considerably cheaper than buyouts. Of course, the simulation hardly provides the final word on which approach is superior, even if it were possible to determine precisely the variance of the error term for a particular product. The approach of giving producers' bonuses to just the bottom eighth of the population may not be optimal. In addition, to ensure pricing by the patent holder at the lower level, the government would have to give somewhat higher producers' bonuses. The analysis does not take into account the cost of administering a coupon scheme, which might well be far greater than the cost of administering a buyout program. With real world products, moreover, demand may not be linear, and marginal cost may not be zero. Finally, the comparison is between a flawed coupon scheme and a perfectly executed buyout program. The government may sometimes spend more on patent buyouts than necessary to compensate patent holders. Of course, the government also might pay excessive producers' bonuses in a coupon program, so the ultimate question is in which program excessive payments are more likely.

In the end, Lichtman's analysis might establish that the optimal regime is a cross between buyouts and coupons. Instead of seeking to induce pricing at a relatively low level, the government

might negotiate directly with a patent holder to price the product at a certain level, and in exchange for this agreement, the government would provide the patent holder with some combination of cash and coupons for relatively low-valuing purchasers.[178] If the government and the patent holder manage to arrive at just the right price, the one that by itself would result in three-quarters of consumers being served if the demand curve is linear, and if the government can police the price agreement successfully, then Lichtman's conclusion that only one of eight dollars needs to be spent correctly will hold. This proposal, of course, has its own risks. The government might agree to too high a price, perhaps even a price above the monopoly price.[179] At least patent buyouts guarantee that the product will be priced at marginal cost,[180] while price ceiling agreements potentially could have no impact at all[181] and, unless the government is successful in identifying all who would benefit from coupons, will leave some potential consumers unserved. Depending in part on the government's ability to determine a satisfactory price ceiling, this negotiated coupon plan might be superior, or a pure buyout or induced coupon scheme might be.

II. HURDLES FOR PATENT PRIZE SYSTEMS

This part introduces additional complications for any prize system. These complications reveal that even if a prize system could determine with perfect accuracy the social value of an invention, it might be inadequate or incomplete. In each section that follows, I explore one set of such complications and examine how they might differentially affect various proposals for prize systems. Part II.A addresses functions of the patent system beyond promoting

178. This would be an opt-in version of the system, giving the patent holder the right to turn the government down. A mandatory version would feature a combination of government price controls and coupons.

179. The situation might be similar to that illustrated in Figure 2.

180. *But cf. infra* notes 308-11 and accompanying text (noting that even if a product is placed in the public domain, the existence of a natural monopoly may prevent pricing at marginal cost).

181. If prices are directly set, rather than by the government agreeing to price ceilings, the government agency conceivably could be used as a means of achieving cartelization by holders of patents for substitute products. *Cf., e.g.*, Curtis J. Milhaupt & Geoffrey P. Miller, *Cooperation, Conflict, and Convergence in Japanese Finance: Evidence from the "Jusen" Problem*, 29 LAW & POL'Y INT'L BUS. 1, 12 (1997) (defining a "regulatory cartel" as one "in which both the regulated and the regulators cooperate in order to enforce market segmentation, control entry, regulate output, and allocate the gains of the cartel's activities among the various participants"); Richard J. Pierce, Jr., *Antidumping Law as a Means of Facilitating Cartelization*, 67 ANTITRUST L.J. 725 (2000) (arguing that firms often use antidumping complaints as a means to facilitate industry cartelization).

innovation, while Part II.B considers whether prize systems might ameliorate or exacerbate existing limitations of the patent system, such as its tendency to promote wasteful patent races and "inventing around." Part II.C discusses the danger that an opt-in prize system would lead to prizes being granted for worthless inventions or inventions that would be developed in the absence of a prize system. Finally, Part II.D analyzes the costs of prize systems, including the costs of the prizes themselves, as well as administrative, litigation, and rent-seeking costs.

My aim is partly to establish a foundation for assessing the costs and benefits of any particular proposal, including the proposals that I will introduce in Part III. It is also, however, to extend the generalizations of Part I. The previous part established that, although an effective prize system could produce social benefits by eliminating deadweight loss and perhaps by increasing innovation incentives, the task of calculating prizes may be more difficult than commentators have suggested. Even the best formula or algorithm may be insufficient to ensure that optimal prizes are given, and the best approach to reducing deadweight loss in one situation may be different from that in another. In assessing the various proposals, I will make a preliminary case that I will extend explicitly in Part III. The argument is that a flexible prize system, allowing and incentivizing inventors to adopt various techniques for avoiding deadweight loss, may be superior to any system based on criteria and procedures set forth in advance in a statute.

A. Patent System Incentives Beyond Invention

F. Scott Kieff offers the only sustained analysis of recent proposals for revolutionizing the patent system.[182] Kieff's analysis covers a great deal of ground, ranging from a critique of Ian Ayres and Paul Klemperer's interesting proposal to limit patent holders' rights in exchange for a lengthening of the patent term,[183] to an assessment of Michael Heller and Rebecca Eisenberg's proposed modifications of the patent system to prevent excessive patenting from suppressing scientific research.[184] In one section of the article, Kieff argues against

182. *See* Kieff, *supra* note 100.

183. Ian Ayres & Paul Klemperer, *Limiting Patentees' Market Power Without Reducing Innovation Incentives: The Perverse Benefits of Uncertainty and Non-Injunctive Remedies*, 97 MICH. L. REV. 985 (1999), *cited in* Kieff, *supra* note 100, at 732. An aspect of the Ayres-Klemperer proposal is discussed *infra* text accompanying notes 427-28, 433.

184. Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. 698 (1998), *cited in* Kieff, *supra* note 100, at 719-23. Kieff explores the issue further in F. Scott Kieff, *Facilitating Scientific Research: Intellectual*

proposals to replace the patent system with a reward-based system, focusing particularly on the Shavell–van Ypersele proposal.[185] Kieff, however, approaches the task from a different vantage point than I have; instead of inquiring as to whether the proposals would make possible accurate valuations of patents, Kieff assumes that they would and then asks whether accepting the proposals would deprive patent law of other functions. This section considers the two such functions that Kieff identifies.

1. Commercialization

Kieff's first argument against prize systems is that even if they are successful in stimulating inventive activity, they may fail in encouraging entrepreneurs to commercialize the inventions.[186] Science in academic journals may be valuable in part because it contributes to our self-awareness in much the same way as research in the humanities,[187] but it is also valued because it leads to practical applications. If there were no incentive to convert pure science into applied science, then our innovative policy would be a failure indeed. The reward proposals discussed in Part I assume away this problem, expecting that release of a patent in the public domain will lead to the production of an invention at marginal cost. This, however, must be a simplification, as firms will enter an industry only if they expect to recover their fixed costs in addition to their marginal costs.[188] The

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Property Rights and the Norms of Science—A Response to Rai and Eisenberg, 95 NW. U. L. REV. 691 (2001).

185. *See* Kieff, *supra* note 100, at 705-17.

186. *Id.* at 707-12.

187. A problem in debates concerning the appropriateness and level of government funding of the humanities is the difficulty of ascertaining whether such funding has been successful. One commentator, for example, concludes that "the NEH has advanced scholarship in America" but cites in support of this claim only that the number of scholarly publications in the humanities "exploded in the period following the creation of the NEH," an explosion that might have had other causes. *See* Alvaro Ignacio Anillo, Note, *The National Endowment for the Humanities: Control of Funding Versus Academic Freedom*, 45 VAND. L. REV. 455, 461-62 (1992). Even if the effect of government funding on the level of academic research could be established, this would leave unanswered the social value of this increase in research. Developments in literary theory are presumably socially valuable for more than their instrumental value (itself almost impossible to ascertain), but quantifying the value of such a public good is largely subjective, given the absence of revealed preferences. Such difficulties, however, should not necessarily prevent government funding, and reward systems easily could be used to foster innovation in the humanities. One virtue of applying the proposal developed in Part III to such funding is that the proposal allows for largely subjective determinations without making funding determinations depend heavily on the preferences of any single individual. *See infra* Part III.A.

188. The dilemma is common to provision of all public goods. *See, e.g.*, Yoram Barzel, *The Market for a Semipublic Good: The Case of the American Economic Review*, 61 AM. ECON. REV. 665, 665 (1971) (discussing the difficulty of achieving zero marginal cost pricing of public goods).

paradox of reward proposals is therefore that if they were truly effective in reducing the price of products to their marginal costs, then as long as there were any fixed costs, no one ever would produce the products. This problem, of course, is often solved, typically with what economists call imperfect competition;[189] we do, after all, have markets with prices close to marginal cost even in areas without intellectual property or other forms of monopoly protection.

There may, however, be products and markets that would exist but for the inability to keep out imitators. As Kieff observes, "[s]econd movers generally enjoy numerous advantages over the first movers against whom they compete."[190] A first mover takes the risks associated with the uncertainty of demand and identifies solutions to both anticipated and unanticipated difficulties.[191] Suppose, for example, that Company *X* has developed a pharmaceutical product but is not yet sure whether it is safe and effective. *X* must decide whether to invest resources in conducting tests of the drug and seeking FDA approval.[192] If *X* anticipates that the drug is so cheap to manufacture that *X* would be able to sell the drug only at or just above marginal cost, *X* will have no incentive to invest the original resources.

The argument is an important one, and it bears a distinguished lineage. In perhaps the most important and famous modern article on patent law, Edmund Kitch offered a rationale for the patent system supplemental to the classical one that the system offers incentives to innovate.[193] Kitch compared patents to prospecting systems for

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189. *See, e.g.*, EKELUND & TOLLISON, *supra* note 30, at 284 (defining "imperfect competition").

190. Kieff, *supra* note 100, at 708.

191. *Id.*; *see also* Michael L. Katz & Carl Shapiro, *Technology Adoption in the Presence of Network Externalities*, 94 J. POL. ECON. 822, 825 (1986) (providing a formal model suggesting the existence of a second-mover advantage in a market in which products may be "sponsored").

192. The FDA approval process is an expensive one for pharmaceutical companies. *See, e.g.*, Richard A. Merrill, *The Architecture of Government Regulation of Medical Products*, 82 VA. L. REV. 1753, 1754 (1996) ("The expense of the studies FDA requires before granting approval—coupled with the substantial time spent conducting these studies and waiting for agency approval—is among the common explanations for the cost of new treatments."); Charles J. Walsh & Alissa Pyrich, *Rationalizing the Regulation of Prescription Drugs and Medical Devices: Perspectives on Private Certification and Tort Reform*, 48 RUTGERS L. REV. 883, 937-39 (1996) (arguing that the FDA review process is "hindered by its entrenched bureaucracy," which results in "duplicative" testing of new drugs and devices). The burdens attendant FDA approval have led to some proposals for self-regulation and privatization of the FDA process. *See* Vivian I. Orlando, *The FDA's Accelerated Approval Process: Does the Pharmaceutical Industry Have Adequate Incentives for Self-Regulation?*, 25 AM. J.L. & MED. 543, 561-63 (1999) (discussing such proposals).

193. Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265 (1977).

mineral rights.[194] In such a system, a prospector who finds minerals on public land could stake a claim to the land and extract minerals from it. In the absence of such a system, no one would have an incentive to search for minerals on public land, because as soon as one found the minerals, others would join to dig out what they could. Kitch's metaphor of the patent holder as prospector has a number of important implications, some of which will be considered below,[195] but for present purposes, his most important observation is that "the patent owner has an incentive to make investments to maximize the value of the patent without fear that the fruits of the investment will produce unpatentable information appropriable by competitors."[196] Kitch concludes, "Only in the case of a patented product is a firm able to make the expenditures necessary to bring the advantages of the product to the attention of the customer without fear of competitive appropriation if the product proves successful."[197]

Before considering the application of this insight to prize systems, it is worth noting that if patent law's concern is to ensure commercialization of inventions, then it is both overinclusive and underinclusive.[198] Patent law is overinclusive because sometimes first-mover advantages will outweigh second-mover advantages.[199] Studies indicate that being the first entrant in a field raises the product's reputation for quality.[200] A first mover may solidify this reputation through brand advertising. The continued value of a brand like Tylenol, despite the existence of generic acetaminophen alternatives, attests to this phenomenon.[201] Patent law is underinclusive because commercializers of unpatentable inventions also face the prospect of

194. *Id.* at 271-75.

195. *See infra* notes 256-59 and accompanying text (noting the danger of rent dissipation by excessive development of the innovation).

196. Kitch, *supra* note 193, at 276.

197. *Id.* at 277.

198. Kitch devotes a section of his article to explaining how specific aspects of patent law reflect his theory. *Id.* at 267-71. Advancing considerably past Kitch's initial insights, Mark Grady and Jay Alexander offer a more robust positive economic theory of patent law. *See* Mark F. Grady & Jay I. Alexander, *Patent Law and Rent Dissipation*, 78 VA. L. REV. 305 (1992).

199. *See* sources cited *supra* note 43.

200. *See* William T. Robinson & Claes Fornell, *Sources of Market Pioneer Advantages in Consumer Goods Industries*, 22 J. MARKETING RES. 305, 308-09 (1985).

201. *See, e.g.*, Lance W. Rook, *Listening to Zantac: The Role of Non-Prescription Drugs in Health Care Reform and the Federal Tax System*, 62 TENN. L. REV. 107, 119-20 (1994) ("Tylenol first began to be sold OTC during Dwight D. Eisenhower's administration. Nonetheless, its annual sales are $719.7 million, even though the same medication is widely and inexpensively available in generic form."). For a study of the diffusion of generic drugs into pharmaceutical markets, see Andrew Tat Tin Ching, Dynamic Equilibrium in the U.S. Prescription Drug Market After Patent Expiration (Feb. 2000) (unpublished Ph.D. dissertation, University of Minnesota, on file with author).

copying.[202] Even an obvious commercial product might not be developed if second-mover advantages are sufficiently strong. These observations, of course, do not necessarily argue for the abolition or extension of patent protection, but they emphasize that the possible existence of second-mover advantages is not necessarily sufficient to overcome any advantages of a prize system alternative to patent.

Kieff appropriately does not claim that commercialization necessarily dooms any reward proposals, but he emphasizes that prize systems should take them into account. Critically, it may be appropriate for rewards to be deferred until after there has been some time for commercialization. For example, he acknowledges, the Shavell–van Ypersele approach might still work, especially if the reward is based on "data from actual sales,"[203] as they suggest would be desirable.[204] Kieff worries, though, that if "the moment of entitlement to the reward is pushed later along the commercialization timeline,"[205] the length of races to achieve and commercialize innovations will be inefficiently extended.[206] Moreover, he maintains, "[t]he shift down the commercialization timeline of the entitlement to the reward will also increase the uncertainty over who will be a reward recipient."[207] Such uncertainty might lead both of two firms arguably responsible for an innovation to refrain from commercializing it.[208]

These are important concerns, but they are not fatal. If multiple firms were unsure about which would ultimately receive the benefit of a reward, they would have strong incentives to cooperate. For example, they might enter into an agreement to commercialize the invention jointly and split the proceeds according to agreed-upon proportions.[209] Moreover, the problem may vanish if the prize system

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202. As Douglas Lichtman argues, the absence of protection for such inventions is becoming increasingly problematic given the decreasing cost of copying technology. *See* Douglas Gary Lichtman, *The Economics of Innovation: Protecting Unpatentable Goods*, 81 MINN. L. REV. 693, 732-33 (1997).

203. Kieff, *supra* note 100, at 710.

204. *See supra* notes 93-96 and accompanying text (discussing Shavell and van Ypersele's proposal to consider sales data).

205. Kieff, *supra* note 100, at 710.

206. *Id.* at 710-11; *see also infra* Part II.B.1 (discussing patent races).

207. Kieff, *supra* note 100, at 711.

208. Moreover, anticipating this outcome may lead to less investment. *Id.* ("The [desirable], invention-inducing power of the reward may decrease, or the undesirable rent-dissipating power may increase.").

209. Such a result would not be uncommon. *See, e.g.*, Joseph Kattan, *Antitrust Analysis of Technology Joint Ventures: Allocative Efficiency and the Rewards of Innovation*, 61 ANTITRUST L.J. 937, 944 (1993) ("[R]ivals may collaborate in a joint venture precisely because they wish to reduce the risk of being left behind in a technology race.").

is an adjunct to the patent system. If the reward regime is opt-in, as Shavell and van Ypersele suggest might be optimal, inventors simply will not opt in if rewards are based on sales and if they expect that the buyout of the patent would lead no firm to have an incentive to commercialize the invention. Similarly, if an investor retains a right to receive a patent before commercialization, with rewards then deferred until such time that the patents literally may be bought out, there will be no uncertainty in such a case about who will benefit from commercialization.[210]

Once the uncertainty problem is overcome, an innovator will have an incentive to commercialize in a prize system. As Kieff recognized, an innovator will have an incentive to commercialize before offering a patent into the public domain in exchange for a reward, because doing so will make the patent more valuable. Even after giving up a patent, though, an innovator will have an incentive to commercialize if the ultimate reward depends on the success of commercialization. Kieff notes correctly that "the size of the reward will have to increase to cover the costs of some commercialization activity in addition to inventive activity,"[211] but if the reward is based on sales, it will do so automatically. An innovator will have the same incentive to advertise and commercialize in such a regime as in the patent regime.[212] The ultimate reward will depend on the full investment, including both the research and the efforts at commercialization before and after the patent is placed in the public domain.

Although Kieff focuses his commercialization argument on a critique of the Shavell–van Ypersele proposal, the above discussion reveals that, with appropriate design choices, the concern may be overcome with such an approach, because rewards depend on ultimate sales in a competitive market. It is a greater concern with proposals in which the value of the reward depends on the value of a patent to a

210. It is not clear whether this is the approach that Shavell and van Ypersele envisioned. *See* Shavell & van Ypersele, *supra* note 19, at 534 (referring simply to a "reward paid by the government for an innovation").

211. Kieff, *supra* note 100, at 711.

212. Economists observe that the amount of advertising will be greater in a monopoly than in a competitive market. *See, e.g.*, SCHERER & ROSS, *supra* note 43, at 592-94. Producers in competitive markets sometimes seek to overcome this obstacle by lobbying for requirements that all producers contribute to joint marketing funds. *Cf.* United States v. United Foods, Inc., 533 U.S. 405 (2001) (invalidating a program requiring all mushroom growers to contribute to a fund advertising mushrooms as a violation of the First Amendment, where the program was not ancillary to a more comprehensive program involving elements other than advertising).

monopolist. Under the Guell and Fischbaum approach,[213] the value of the reward would depend on profits in a test market, in which the patent holder would be permitted to advertise.[214] This might overstate the eventual value, since the patent holder would have little incentive to advertise after receiving an award based on the test market. If such advertising is important and socially beneficial,[215] their proposal may need revision. Similarly, in the Kremer approach, the winning auction bid would depend on how much a monopolist would be able to earn from a patent.[216] It is thus possible that the original patent holder will receive the monopoly profits even though the innovation will not be commercialized in a competitive market. Even market-based rewards ideally should be contingent on a demonstration that the product will be or already has been commercialized.

2. Screening

Kieff also critiques the Shavell–van Ypersele proposal for failing to screen valid from invalid patents.[217] Measuring the sales of a product to determine demand for that product, Kieff correctly observes, "does not establish that the invention itself would have been patentable."[218] The problem stems in part from the difference between a product and an innovation. I noted earlier that the Shavell–van Ypersele proposal would have difficulty when a product arguably included a number of different innovations;[219] Kieff's point is that it may not be possible to determine whether a product reflects even a single innovation. In the patent system, by contrast, "[t]he same core legal rules that drive the patent system simultaneously provide the system with its own method for deciding which inventive activities are eligible to receive the benefit of a patent."[220] The patent system seeks

213. *See supra* Part I.A. This concern might be relatively slight in the pharmaceutical context with which they are specifically concerned, since the cost of producing pharmaceuticals is low. Note that Guell and Fischbaum assume that the patent buyout would take place only after a drug is approved and test-marketed in a limited location. Guell & Fischbaum, *supra* note 29, at 225.

214. *See* Guell & Fischbaum, *supra* note 29, at 225.

215. Some commentators argue that advertising of pharmaceuticals may in fact be socially harmful. John Rizzo, for example, shows empirically that advertising tends to make consumers more price inelastic, thus leading them to pay more for drugs. *See* John A. Rizzo, *Advertising and Competition in the Ethical Pharmaceutical Industry: The Case of Antihypertensive Drugs*, 42 J.L. & ECON. 89 (1999).

216. *See supra* text accompanying notes 113-14.

217. Kieff, *supra* note 100, at 712-17.

218. *Id.* at 713.

219. *See supra* notes 101-05 and accompanying text.

220. Kieff, *supra* note 100, at 714.

to ensure that an invention is useful,[221] novel,[222] nonobvious,[223] and fully disclosed.[224] These would all be potentially relevant in a prize system as well, but they cannot necessarily be determined just by examining market conditions.

The problem, moreover, is one that cannot be solved merely by anchoring the prize system to the existing patent system. If inventors were required to obtain patents that they then would formally yield for a reward, then the existence of the patent would reveal that the Patent and Trademark Office believed that the invention met the criteria of patentability. The patent system, however, does not rely just on the Patent and Trademark Office, as the issuance of a patent provides only prima facie evidence of patent validity.[225] In the existing system, potential infringers have strong incentives to seek out evidence that might undermine a patent's validity, for example by "scouring public and private sources around the world" for prior art,[226] or even identifying prior art in their own files of which the patent holder might not have been aware.[227] Finding evidence that proves the invalidity of a patent will allow activity that otherwise would be infringement, and preparing a case that might lead to invalidation may allow a competitor to enter an agreement to license the patent at a relatively low rate.[228] In a prize system, once a patent is released

221. 35 U.S.C. § 101 (2000) (allowing patents for "new and useful improvements thereof"). In *Diamond v. Diehr*, 450 U.S. 175, 185 (1981), the Supreme Court noted that the usefulness requirement limits the potential scope of patentable subject matter. In particular, the Court found that abstract ideas are not "useful" in the sense specified by § 101. *Id.*; *see also In re* Alappat, 33 F.3d 1526, 1541-44 (Fed. Cir. 1994) (en banc) (analyzing § 101).

222. § 102(a) (requiring that for a patent to be obtained, the invention not be "known or used by others . . . before the invention thereof by the applicant for patent").

223. § 103(a) ("A patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.").

224. § 112 ("The specification shall contain a written description of the invention . . . in such full, clear, concise, and exact terms as to enable any person skilled in the art . . . to make and use the same . . . .").

225. *See* § 282 ("A patent shall be presumed valid."); Pennwalt Corp. v. Akzona Inc., 740 F.2d 1573, 1578 (Fed. Cir. 1984) (requiring "clear and convincing" evidence to overcome the presumption of validity).

226. Kieff, *supra* note 100, at 713.

227. *Id.* at 712-13. A practioner's guide to defending an infringement action suggests, "Don't forget to review your client's own files for pertinent prior art." David A. Dillard & Gary J. Nelson, *Presentation of Invalidity Defenses*, 493 PRACTICING L. INST. PAT. LITIG. 519, 535 (1997).

228. On the relationship between threats to sue and patent licensing, see Jin-Li Hu, Choosing Litigation and Patent Licensing: An Inquiry into the Relationsbip Between the Legal System and R&D (1995) (unpublished Ph.D. dissertation, SUNY Stony Brook, on file with author).

into the public domain, there will be no incentive for anyone to argue for its invalidity.

Patent validity, however, need not be the sine qua non for receipt of a prize. The criteria that a prize system employs could be different from those in the patent system. Some classes of patentable inventions might be excluded from a prize system, perhaps because prizes for those classes might be too difficult to calculate. At the same time, prizes might be offered for some innovations or activities that would not qualify for patent protection. The purpose of providing such prizes could not be to reduce deadweight loss from patents, but prizes could be used to reward other useful activities. Prizes, for example, might be useful to encourage commercialization of products that otherwise would not be commercialized.[229] If patent and copyright laws provide inadequate protection and thus production of innovation in, say, fashion,[230] a prize system conceivably could be used to fill in the gaps. The first designer to repopularize bell-bottoms, thus stimulating a market that otherwise would not have existed, would receive a prize when other labels followed suit. Perhaps we would not want a prize system in this area; innovation in fashion arguably is a social cost rather than a social benefit, leading everyone to wasteful replacement of wardrobes. The case for and against providing incentives for this form of innovation, however, may be different in a world of patents than in a world of prizes.

Similarly, a prize system might well differ from a patent system in not producing black-and-white validity judgments at all. A patent either is or is not valid, or at least a court hearing a validity challenge must make one determination or the other on every patent claim.[231] It may be useful for patent law to make binary judgments

229. Commercialization might not occur in the absence of a prize because of second-mover advantages, even if the product idea was not innovative. *See supra* text accompanying notes 190-92. Indeed, to make Kitch's comparison of patents and prospecting complete, a prize system might be an alternative to prospecting systems, at least if the only aim is to ensure adequate incentives for prospecting. *But cf. infra* text accompanying notes 240-44 (discussing other virtues of the prospecting approach).

230. I choose fashion because fashion patterns generally cannot be copyrighted. *See* Whimsicality, Inc. v. Rubie's Costumes Co., 891 F.2d 452, 455 (2d Cir. 1989). For a critique of the current regime as inconsistent with general principles of copyright law, see Leslie J. Hagin, *A Comparative Analysis of Copyright Laws Applied to Fashion Works: Renewing the Proposal for Folding Fashion Works into the United States Copyright Regime*, 26 TEX. INT'L L.J. 341, 387 (1991).

231. Different courts, of course, might come to different conclusions. Indeed, in a recent empirical analysis of over ten thousand patent cases, Kimberly Moore concluded that patent holder win rates differed considerably by district. *See* Kimberly A. Moore, *Forum Shopping in Patent Cases: Does Geographic Choice Affect Innovation?*, 79 N.C. L. REV. 889, 916-20 (2001). For example, the infringer won seventy percent of cases in the District of Massachusetts and only thirty-two percent of cases in the Northern District of California, a discrepancy which was highly

even if the world exhibits shades of gray. Innovations may be more or less nonobvious, but it is presumably impractical for the patent office to grant two-thirds of a patent.[232] It might not be so impractical to provide partial prizes when an innovation would be close to the patentability line. In addition, it may be impractical for the patent office to consider whether and when an innovation likely would have been developed and commercialized in the absence of the applicant's discovery, a criterion that some have suggested that the patent office should apply.[233] The benefits and costs of including such an analysis in a prize system might be different, depending on the form that the prize system would take. In a modification of the Shavell–van Ypersele proposal, for example, government officials might try to estimate the portion of sales of a product that would not have existed but for the claimed innovation.

These considerations, of course, do not undermine the need for a prize system to have some screening mechanism to identify worthwhile innovations, but reveal that the mechanism need not necessarily be the patent system itself.[234] Ultimately, a prize system must have some means of distinguishing worthwhile from other inventions, but the success of the patent system in distinguishing innovative products from retreads does not imply that no other system could accomplish the same task. Sometimes, anchoring a prize system

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statistically significant. *Id.* at 917 tbl.8. Such discrepancies suggest that the probability of victory depends greatly on the identity of the judge, and even with a particular judge it is possible that there is some randomness in outcomes.

232. The notion of two-thirds of a patent may not be as absurd as it sounds, given the possibility of varying the patent term length on a patent-by-patent basis. Most scholars who have tried to determine the optimal patent length, however, have not considered making patent life determinations on a case-by-case basis. *See, e.g.*, WILLIAM D. NORDHAUS, INVENTION, GROWTH, AND WELFARE 76-86 (1979); C. Michael White, *Why a Seventeen Year Patent?*, 38 J. PAT. OFF. SOC'Y 839, 839 (1956). The current approach to patent terms is sometimes called "variable," since the term is twenty years from the date of filing. The patent term, however, does not depend on the novelty of the invention. *Cf.* Mark A. Lemley, *An Empirical Study of the Twenty-Year Patent Term*, 22 AIPA Q.J. 369, 385 tbl.1 (1994) (providing a numerical assessment of mean patent length with fixed and variable terms). A recent commentator has argued that patent term should vary depending on factors such as the interest rate at the time the patent is issued. *See* Frank Partnoy, Finance and Patent Length (Univ. San Diego Law & Econ. Research Paper No. 19, 2001), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=285144 (last visited Oct. 25, 2002). In any event, uncertainty about enforcement of a patent can in effect create a partial patent. *See generally*, Ayres & Klemperer, *supra* note 183, at 987-88 (indicating that uncertainty can increase "the chance that invalid patents will be enforced").

233. *See* sources cited *supra* note 45.

234. Kieff acknowledges that a prize system need not require a patentable invention. For example, he states, that the Shavell–van Ypersele system "may be indifferent between new technologies and revived ones." Kieff, *supra* note 100, at 713. Kieff worries, though, that "[e]very market having large demand would generate droves of reward claimants each asserting to have made some contribution." *Id.*

to the patent system may be the simplest and best approach. Even though Kieff shows that the issuance of a patent cannot be sufficient, he acknowledges that Kremer's approach avoids the objection, because bidders "will be sure not only to acquire information about the market demand for the information claimed in the patents but also about patent validity."[235] Other prize systems will need to adopt some other approach, one that will assure that decisions on prizes take into account all considerations relevant to that system, ranging from the innovativeness of the inventions to the accuracy of claims about sales data and consumer demand.

B. The Common Pool Problem

So far, we have explored two vices of the patent system, its tendency to impose deadweight loss and its resulting dampening of innovation incentives, and two virtues, its effectiveness in encouraging commercialization of innovations and in screening prospective patent recipients to ensure sufficient innovativeness. This alignment of pluses and minuses is misleading, however, most importantly because the patent system can produce both benign and malign innovation incentives. Both types of incentives are associated with what is known as the "common pool" problem, discussed frequently in the context of fisheries.[236] As H. Scott Gordon noted, in "sea fisheries the natural resource is not private property; hence the rent it may yield is not capable of being appropriated by anyone."[237] That is, even though a fishery conveys some social benefit, the competition for the benefit will produce a fully offsetting cost.[238] To switch metaphors, if I promise that I will distribute $100,000 among all who come to a particular stadium, the total time costs of those who come will amount to about $100,000.[239]

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235. *Id.* at 715.

236. The term "common pool" itself is an old one, referring to the analogous situation of common pools of oil shared by multiple drillers. *See, e.g.*, R.F. Kahn, *Some Notes on Ideal Output*, 45 ECON. J. 1, 18 (1935).

237. H. Scott Gordon, *The Economic Theory of a Common-Property Resource: The Fishery*, 62 J. POL. ECON. 124, 130-131 (1954).

238. Gordon explains:

> [S]ince average cost is the same for all grounds and the average productivity of all grounds is also brought to equality by the free and competitive nature of fishing, this means that the inframarginal [fishing] grounds also yield no rent. It is entirely possible that some grounds would be exploited at a level of *negative* marginal productivity.

Id. at 131-32.

239. Rent dissipation, however, need not use up the entirety of the $100,000, if different people would suffer different costs from attending the event. Suppose, for example, that there are

This problem animated Kitch's comparison of the patent system to a prospecting system.[240] Kitch, as we have seen, revealed that a patent would give a patent holder incentives to commercialize an invention that otherwise might not be developed because of second-mover advantages.[241] In the absence of patent protection, no one will have any incentive to search for a common pool if finding the pool will not allow the finder to exploit it. Kitch, moreover, recognized that the patent system also was a solution to the problem of how to manage a pool once it is found. Just as a prospector will have incentives to limit the number of people who can mine for a mineral, so too will a patent holder have an incentive to limit the number of inventors who can seek to improve upon the original patent.

Emphasizing that "a patent 'prospect' increases the efficiency with which investment in innovation can be managed,"[242] Kitch notes that "the patent owner [is] in a position to coordinate the search for technological and market enhancement of the patent's value so that duplicative investments are not made and so that information is exchanged among the searchers."[243] Though Kitch does not develop the point fully,[244] a patent holder owns the pool and therefore is in a position to prevent competing factions from emptying the pool. Once a particular innovation is developed, it might be clear that improvements to it would produce an estimated $100,000 in additional benefit exploitable by the developers, but if that is so, about the same amount will be spent if there is competition to secure pieces of this social benefit. A patent holder, by contrast, can ensure that the marginal benefit of expenditures is equal to the marginal cost.

So far, this discussion simply shows another benefit of the patent system. Patents, however, do not entirely solve the common

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51,000 individuals for whom the time cost of the event is $1, and for everyone else, it is $2. With perfect information, the 51,000 will attend and each receive slightly less than $2, for a surplus of almost $1 each. Nobody else will attend. A similar effect could exist with any common pool problem. Because some people with relatively low costs will necessarily participate, fewer of those with higher costs may participate than would be necessary to consume the common pool entirely. Risk aversion may also limit the extent of rent dissipation. *See* Arye L. Hillman & Eliakim Katz, *Risk-Averse Rent Seekers and the Social Cost of Monopoly Power*, 94 ECON. J. 104 (1984) (providing a formal model of the effect of risk aversion on rent-seeking).

240. Indeed, Kitch begins his article by citing an essay by Yoram Barzel that "points out that the exploitation of technological information has much in common with fisheries, public roads, and oil and water pools—all resources not subject to exclusive control." Kitch, *supra* note 193, at 265 (citing Yoram Barzel, *Optimal Timing of Innovations*, 50 REV. ECON. & STAT. 348, 348 (1968)).

241. *See supra* notes 193-202 and accompanying text.

242. Kitch, *supra* note 193, at 276.

243. *Id.*

244. The point is developed by Grady & Alexander. *See supra* note 198; *see also infra* notes 252-54 and accompanying text.

pool problem for two reasons. First, in solving the ex post common pool problem, patents may create an ex ante common pool problem, as multiple inventors compete for the right to own the patent in the first place. Second, because a patent is not infinitely broad, competitors may "invent around" the patent, developing cumbersome alternatives to the initial patent. The following sections explore these problems and consider their implications for prize systems. While these are problems associated with the existing patent system, various prize proposals might exacerbate them. At the same time, a prize system may strengthen its case by ameliorating the problems.

1. Patent Races

That the patent system might solve one common pool problem at the expense of another was noticed shortly after Kitch published his initial article. Characterizing Kitch's argument, Donald McFetridge and Douglas Smith acknowledged that "[t]he patent as a prospect prevents competitive dissipation of these private returns by homogeneous rival inventors,"[245]—for example, by allowing the patent holder to prevent "premature commercial introduction" of the product.[246] The "surplus-increasing" effect of patents, however, "is dissipated in a resource-using rivalry for the patent itself."[247] The basic intuition is simple. If a patent holder is given ownership of a common pool of a certain value, the incentive to become a patent holder increases by the same amount. Therefore, the same "homogeneous rival inventors" who would have competed in improving an invention will compete in the initial development of it, dissipating the patent rents.[248]

In a reply to the McFetridge-Smith critique, Kitch noted that potential inventors might overcome the common pool problem by making agreements amongst themselves to limit excessive innovation.[249] Offering a Coasean efficiency story, Kitch observes that with zero transaction costs, "the rent dissipation problem

245. Donald G. McFetridge & Douglas A. Smith, *Patents, Prospects, and Economic Surplus: A Comment*, 23 J.L. & ECON. 197, 198 (1980).

246. *Id.* The focus on premature commercial introduction, as opposed to excessive research and development of improvements, follows from Barzel, *supra* note 240.

247. McFetridge & Smith, *supra* note 245, at 198.

248. Surprisingly, full rent dissipation is possible even if in equilibrium, only one firm innovates. For a formal model with this result, see Partha Dasgupta & Joseph Stiglitz, *Industrial Structure and the Nature of Innovative Activity*, 90 ECON. J. 266, 284-87 (1980).

249. Edmund W. Kitch, *Patents, Prospects, and Economic Surplus: A Reply*, 23 J.L. & ECON. 205, 205 (1980).

disappears."[250] Although transaction costs are positive, Kitch argues that they will be lower "[a]t the early stages of innovation,"[251] and patent law appropriately solves the common pool problem later, where private ordering is less likely to achieve a satisfactory solution. A separate possibility, developed by Mark Grady and Jay Alexander, is that patent law seeks to provide a balance between the common pool problems.[252] Thus, the developer of "an invention likely to inspire a number of slightly modified duplicates" will tend to receive a broader patent than one whose invention does not signal likely improvements,[253] because in the former case the danger of the ex post common pool problem is greater than in the latter case.[254]

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250. *See id.* at 205. Kitch supports this argument with the following quote from Barzel:

> The fact that many information situations have the potential for waste does not necessarily mean that waste actually occurs. If, in the aggregate, these actions produce a negative product, arrangements that successfully restrain them or reduce their impact will generate a positive return. An implicit, but crucial, assumption of the model is zero costs of transacting.

Id. at 250 n.3 (quoting Yoram Barzel, *Some Fallacies in the Interpretation of Information Costs*, 20 J.L. & ECON. 291, 292 (1977)).

251. *Id.* at 205-06. Kitch supports this argument by claiming that "the number of firms with the necessary comparative advantage to exploit the inventive possibility will be small and the uncertainties attached to each possibility make it easier to agree upon a division of activities, since the value of what any one firm is either giving up or gaining is unclear." *Id.* at 206. This argument is not persuasive. The number of firms that might exploit a possibility will presumably be smaller after an innovation is initially made. Moreover, uncertainty about relative prospects may make agreements more difficult to achieve, particularly if each firm is overconfident about its own prospects. Such overconfidence might occur frequently, given the existence of overconfidence and overoptimism biases. *See* Christine Jolls, *Behavioral Economics Analysis of Redistributive Legal Rules*, 51 VAND. L. REV. 1653, 1659 & n.22 (1998) (citing an unpublished bibliography listing over two hundred articles on unrealistic optimism). *See generally* David Dunning et al., *A New Look at Motivated Inference: Are Self-Serving Theories of Success a Product of Motivational Forces?*, 69 J. PERSONALITY & SOC. PSYCHOL. 58 (1995) (assessing the source of self-serving biases); Russell B. Korobkin & Thomas S. Ulen, *Law and Behavioral Science: Removing the Rationality Assumption from Law and Economics*, 88 CAL. L. REV. 1051, 1091-95 (2000) (examining the effect of overconfidence bias in legal contexts); Neil D. Weinstein, *Unrealistic Optimism About Future Life Events*, 39 J. PERSONALITY & SOC. PSYCHOL. 806 (1980) (providing an early study of such biases).

252. *See* Grady & Alexander, *supra* note 198, at 316-21. For a useful summary of the theory, see Matthew Erramouspe, Comment, *Staking Patent Claims on the Human Blueprint: Rewards and Rent-Dissipating Races*, 43 UCLA L. REV. 961, 976-79 (1996). For comments and criticisms, see Donald L. Martin, *Reducing Anticipated Rewards from Innovation Through Patents: Or Less Is More*, 78 VA. L. REV. 351, 351-58 (1992); Robert P. Merges, *Rent Control in the Patent Districts: Observations on the Grady-Alexander Thesis*, 78 VA. L. REV. 359, 359-81 (1992); A. Samuel Oddi, *Un-Unified Economic Theories of Patents—The Not-Quite-Holy Grail*, 71 NOTRE DAME L. REV. 267, 284-85 (1996).

253. *See* Grady & Alexander, *supra* note 198, at 318.

254. Grady and Alexander develop their positive economic theory by arguing that the scope of patentable subject matter and the requirements of patentability are best explained by the desire to minimize rent dissipation. *See id.* at 322-49.

Regardless of how effectively the patent system achieves a balance between the two common pool problems, however, patent races will occur. Patent races present three related problems. The first is excessive innovative activity.[255] This concern may seem strange given the concerns of prize system proponents that the patent system produces too little inventive activity. Shavell and van Ypersele, for example, show that any given inventor will invest too little because she will not anticipate that she will be able to capture the full social benefit of her innovations.[256] The problem is that Shavell and van Ypersele assume a single inventor pursuing a particular prospect, rather than multiple inventors competing.[257] These two models are ultimately reconcilable. The common pool from the perspective of potential inventors will be smaller in a patent system as a result of patent holders' inability to capture social benefits above monopoly profits,[258] but the competition among multiple inventors will lead to the consumption of a greater portion of this smaller pool than if one inventor owned the entire pool.[259]

The two effects thus pull in competing directions. On one hand, the ability of a patent holder to appropriate only monopoly profits and not the full social benefit will decrease the amount of research activity. On the other hand, each competitor's concern with the private rather than social marginal benefits and costs of its research endeavours will tend to lead to excessive research activity. Even if the two effects happen to offset one another, producing just the right amount of investment in social innovation, there remains a second problem with patent races—that research efforts may be duplicative. When many different inventors work independently toward the same goal, society's resources may be inefficiently channeled. Kitch himself recognized this danger in the ex post common pool problem with his

255. As Professor Rai notes, though without elaboration, "the greater the reward associated with patent rights, the greater the possibility of patent races that produce excessive or duplicative investment." Rai, *supra* note 66, at 199.

256. *See, e.g.*, *supra* notes 76-77 and accompanying text.

257. Shavell and van Ypersele do briefly acknowledge the problem of patent races. *See* Shavell & van Ypersele, *supra* note 19, at 542-43. They conclude simply that "[b]ecause the race to be first is a factor that afflicts both [patent and reward] systems, and because the information needed to address it under either seems to be of the same character, consideration of the race to be first does not seem to bear on the comparison between reward and patent." *Id.* at 543.

258. For an early formal model suggesting that there will be too little research-and-development activity for this reason, see Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609, 619-22 (1962).

259. The result of competition may thus be technical progress that is *greater* than the social optimum. *See, e.g.*, Partha Dasgupta et al., *Invention and Innovation Under Alternative Market Structures: The Case of Natural Resources*, 49 REV. ECON. STUD. 567, 579 (1982).

observation that a patent owner can ensure that "duplicative investments are not made,"[260] but the problem in research leading to patent awards is equally significant. The problem is similar to one often noted in connection with securities markets, that securities analysts will have incentives to engage in excessive and duplicative research because the private value of such research is greater than the social value.[261]

A third problem with patent races is that they may reinforce inefficient industrial structures. Richard Gilbert and David Newbery have argued, for example, that a monopolist will expend resources on wasteful research and development simply as a means of protecting its market position, even if potential rivals in a patent race might be more efficient.[262] The problem is most prominent in an asymmetrical race, in which the monopolist has more at stake than any other inventors.[263] In such a race, a potential competitor may be deterred from even participating, "because the strategic interactions between the players are such that the incumbent would outdo any reasonable effort made by the challenger in order to stop the challenger being first to reach the finishing line."[264] Anticipating a lack of competition, the monopolist will proceed at the pace it would have taken in the

260. Kitch, *supra* note 193, at 276.

261. The seminal article making this point is Jack Hirshleifer, *The Private and Social Value of Information and the Reward to Inventive Activity*, 61 AM. ECON. REV. 561, 563-67 (1971). *See also* Lynn A. Stout, *Are Stock Markets Costly Casinos? Disagreement, Market Failure, and Securities Regulation*, 81 VA. L. REV. 611, 667-71 (1995) (providing a useful discussion of Hirshleifer's argument). As Jules Coleman similarly explains, "From an individual's perspective, the value of new information, and hence of investing in generating it, derives from *technology*, gains from allocating resources more efficiently, and *distribution*, wealth transfers that follow from price changes." JULES L. COLEMAN, RISKS AND WRONGS 151 (1992). Hirshleifer offers a brief but incomplete application to patent law, noting that even in the absence of a patent regime, inventors might be able to profit by speculation, so that, for example, Eli Whitney might have sold cotton futures. *See* Hirschleifer, *supra*, at 570-72.

262. *See* Richard J. Gilbert & David M.G. Newbery, *Preemptive Patenting and the Persistence of Monopoly*, 72 AM. ECON. REV. 514, 518 (1982). For a critique of the model, arguing that the possibility of licensing will undermine "preemptive patenting," see Stephen W. Salant, *Preemptive Patenting and the Persistence of Monopoly: Comment*, 74 AM. ECON. REV. 247, 247-50 (1984). Salant argues that "[i]f such transactions are permitted, entrants who can develop technologies more efficiently than the incumbent *always* win the patent race, preemptive patenting *never* occurs, and—while production will again be monopolized—there is no more reason to expect that the incumbent will acquire the entrant's patent than that the entrant will acquire the incumbent's patent." *Id.* at 247.

263. *See, e.g.*, Christopher Harris & John Vickers, *Patent Races and the Persistence of Monopoly*, 33 J. INDUS. ECON. 461, 461-62 (1985).

264. *See id.* at 461. Harris and Vickers acknowledge that challengers will not always be deterred—for example, where they may have some offsetting advantage relative to the monopolist. *Id.*

absence of any competition.[265] This outcome may be desirable, as redundant research is eliminated. Whether one favors it depends in part on one's view of how long it will take inefficient monopolists to be overcome by the process that Joseph Schumpeter has called "creative destruction."[266]

Even in a patent regime, patent holders may avoid some of the harmful consequences of a patent race by disclosing some or all of their research activities. In a recent article,[267] Gideon Parchomovsky argues that "in many patent races the superior strategy for one or more of the competing firms would be to prevent other firms from winning the race by publishing their research findings."[268] A laggard in a patent race might not have developed sufficient research findings to support a patent, but these research findings may be sufficient to make a competitor's minor improvements over them insufficient for patenting. By preemptively publishing, the laggard may help its "financial ability to engage in other research projects in the future" and allow the laggard to "use the information it published in future projects at no cost."[269]

Parchomovsky's thesis is controversial. Douglas Lichtman, Scott Baker, and Kate Kraus argue that because American patent law awards a patent to whoever is the first to conceive of an invention, laggards in a patent race are unlikely to publish preemptively.[270] The same principle, however, leads them to observe that leaders in a patent race may strategically disclose information before filing a patent application, because "while such disclosures hurt the leader, they also benefit him by driving laggards out of the race and in that way decreasing the chance that one of those laggards will leapfrog the leader and win the patent."[271] Rebecca Eisenberg, meanwhile, has argued that preemptive disclosure is more likely by potential users of

265. For a model showing that the winner of a patent race will proceed as if he is the only player in the race, see Christopher Harris & John Vickers, *Perfect Equilibrium in a Model of a Race*, 52 REV. ECON. STUD. 193, 193-209 (1985).

266. *See* JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM AND DEMOCRACY 83-84 (3d ed. 1950) (referring to innovation as part of a process of "creative destruction" through which a dominant leader eventually is overcome).

267. Gideon Parchomovsky, *Publish or Perish*, 98 MICH. L. REV. 926 (2000).

268. *Id.* at 927.

269. *Id.* at 930.

270. *See* Douglas Lichtman et al., *Strategic Disclosure in the Patent System*, 53 VAND. L. REV. 2175, 2178-79 (2000).

271. *Id.* at 2179.

an innovation, such as pharmaceutical companies hoping to use DNA sequences, than by competitor producers.[272]

Regardless of the ultimate resolution of this debate, strategic disclosure does not eliminate the patent race problem, for two reasons. First, while strategic disclosure may prevent some duplicative research effort prospectively, it does not eliminate any research redundancy occurring prior to the strategic disclosure itself. Second, Parchomovsky recognizes that the net social welfare effects of strategic disclosure may be equivocal. On one hand, Parchomovsky argues that strategic disclosure "circumvents the troublesome tradeoff" that leads to patents but also to deadweight loss.[273] At the same time, however, "[t]he availability of preemptive publication reduces the expected average payoffs of the race participants and may consequently diminish, in some cases, the ex ante incentive to engage in R&D."[274] If strategic disclosure were to occur and prevent patents in all cases, the patent system's incentives to innovate would be eliminated altogether.

The possibility of early disclosure of patents is thus a promising antidote to one of the patent system's ills, but one that the patent system itself may be unable to promote fully. Prize systems, however, may offer an answer. Conceivably, a prize system could be used to compensate parties for releasing information even if that information would be insufficient for patentability.[275] If researchers have the option of obtaining a reward by releasing preliminary information, research could become more of a cooperative process than a competitive one.[276] As long as the eventual reward for an innovation is distributed among contributors to it based on information released by those contributors, researchers will have incentives to release information immediately, rather than waiting to achieve the threshold of completeness that the patent system requires.

This step may not eliminate the redundancy of a patent race altogether, because it might create a number of smaller research

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272. *See* Rebecca S. Eisenberg, *The Promise and Perils of Strategic Publication to Create Prior Art: A Response to Professor Parchomovsky*, 98 MICH. L. REV. 2358, 2369-70 (2000).

273. *See* Parchomovsky, *supra* note 267, at 944.

274. *Id.* Parchomovsky also argues that strategic disclosure may lead to inefficient expenditures by race participants on "monitoring competitors' research activities," which, while "not entirely wasteful, . . . [are] an additional cost that will slow down the development of new products and processes." *Id.* at 944-45.

275. *See supra* note 230 and accompanying text.

276. Calandrillo makes a distinct but related point. "Kitch's discussion of the patent system implies that the negative effects of socially wasteful duplicative effort can be mitigated if property rights (or rewards) are bestowed relatively early on in the process so as to shorten the period of simultaneous investment by multiple parties." Calandrillo, *supra* note 20, at 353.

races. Thus, researchers would compete for the prize for each part of a larger project. Different researchers, however, might be able to specialize in different parts of a project that could lead to only a single profitable patent, either by explicit agreement or by implicit cooperation.[277] Moreover, a prize system might penalize researchers who fail to cooperate by reducing the overall level of the prize to just enough so that only one team of researchers (or whatever number of teams provides an optimal balance between the goals of fostering competition and reducing redundancy) would have an incentive to work on it. This is analogous to imposing a sufficiently large tax on oil extraction so that the optimal amount of oil extraction from a common pool occurs, or to letting the person who picks low-lying fruit keep only half the apples so that a second person will have an incentive to climb a ladder rather than fight for the more accessible apples. Alternatively, a prize system might reduce the level of the prize if the party that should have bowed out of the patent race turns out to win it, although this approach would require some way of identifying the rightful team, which might not be the first team to begin the research.

Some proposals for patent rewards would be more conducive than others to encouraging cooperation by sharing prizes and discouraging redundancy by reducing prizes. It would seem difficult to integrate this approach with Kremer's system, for example, because the patent holder in his system receives the full social value of the patent. It is more plausible as an adjunct to the Shavell–van Ypersele approach, as the government agency responsible for rewards could calculate the overall demand for an innovation and then distribute rewards among all contributors. The task of determining how much to give to each contributor is not a trivial one, however, and the task of determining an appropriate penalty for failure to cooperate or reduction in the optimal size of a prize is still more difficult to model. Anticipation of inefficient choices in distributing rewards among participants might hamper efficient allocation of research spending.

In the end, shared rewards and reduced prizes in common pool situations may be more appropriate in some contexts than in others. Shared rewards, for example, may be superior to rewards that give the entire prize in a patent race to a single winner when the amount of

277. Such division of the market potentially could raise antitrust concerns. *See, e.g.*, United States v. Topco Assocs., Inc, 405 U.S. 596, 608-09 (1972) (striking down as per se illegal a division of territories by members of a cooperative association). Antitrust law, however, is often sensitive to efficiency justifications. *See* Timothy J. Muris, *The Federal Trade Commission and the Rule of Reason: In Defense of* Massachusetts Board, 66 ANTITRUST L.J. 773, 775 (1998) (characterizing an FTC decision not as claiming "that conduct is never per se illegal" but as saying "that the courts should always listen to justifications"). Congress in any event could specify in the legislation creating a prize system that such agreements are permissible.

duplication in research is likely to be high and when determining relative contributions is relatively straightforward. Winner-take-all prizes may be superior in other situations, as well as when patent race competitors may be able to eliminate some of the problems of a patent race through private bargaining.[278] The proposals for patent prize systems explored in Part I cannot be faulted for causing redundant research relative to the existing patent systems. But they can be faulted for failing to exploit an opportunity to overcome a weakness of the patent system. An ideal prize system would allow for shared rewards in contexts in which shared rewards are more efficient than the alternative.

2. Inventing Around

The problem of inventing around has much in common with the problem of patent races. Imagine a patent race in which two different companies are seeking to achieve the same practical goal—say, developing a cure for a disease. Now, change the hypothetical in two different ways. First, the companies are pursuing different means, for example by pursuing medicines based on different perceived vulnerabilities of an infectious agent.[279] Second, one company has already won the race, having received a patent on its invention and commercialized its invention, charging monopoly profits. If the other company continues its work, it may be said to be trying to "invent around" the first company's patent, trying to produce the same benefit but in a new way. The phenomenon of inventing around is thus the same as the phenomenon of a patent race, except one participant has already won the race and the other participant is seeking to achieve the same goal in another way. Inventing around presents similar problems of excessive and functionally redundant innovative activity as patent races.

Some commentators have treated the problem of inventing around as benign. The U.S. Court of Appeals for the Federal Circuit has even trumpeted inventing around as a benefit of the patent system, reasoning that patent protection stimulates innovation by

278. *See, e.g.*, Parchomovsky, *supra* note 267, at 948-50 (discussing the effect of private bargaining on a patent race).

279. For example, the HIV virus might be attacked through protease inhibitors as well as by vaccines seizing on different mechanisms. Even though protease inhibitors have shown promise in allowing many individuals infected with HIV to live normal lives, work continues on an AIDS vaccine, in part because of the high cost of protease inhibitor treatment. *See* Philip A. Leider, Comment, *Domestic AIDS Vaccine Trials: Addressing the Potential for Social Harm to the Subjects of Human Experiments*, 88 CAL. L. REV. 1185, 1190-97 (2000) (discussing the need for a vaccine despite recent advances in treatment).

encouraging inventing around.[280] Accordingly, inventing around is permitted, although under the doctrine of equivalents, infringement cannot be avoided by insignificant changes to the patent.[281] This doctrine may reflect an appropriate balance in patent policy,[282] but commentators have been skeptical of the claimed social benefits of inventing around. Louis Kaplow, for example, notes that "[s]uch invention provides no social benefit if the new invention is no better than the first."[283] Even if there is a possibility that the new invention might be better than the original one, the private benefit to the new inventor might be considerably greater than the social benefit and thus social resources might be channeled inefficiently toward reinventing the wheel and away from other research.[284] In addition, while inventing around ultimately may result in lower prices to consumers, "there might be a serious diminution in incentive to come up with the [original] invention in the first place."[285]

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280. *See, e.g.*, Hilton Davis Chem. Co. v. Warner-Jenkinson Co., Inc., 62 F.3d 1512, 1520 (Fed. Cir. 1995) ("The ability of the public successfully to design around—to use the patent disclosure to design a product or process that does not infringe, but like the claimed invention, is an improvement over the prior art—is one of the important public benefits that justify awarding the patent owner exclusive rights to his invention."), *rev'd*, 520 U.S. 17 (1997); State Indus., Inc. v. A.O. Smith Corp., 751 F.2d 1226, 1235-36 (Fed. Cir. 1985) ("One of the benefits of a patent system is its so-called 'negative incentive' to 'design around' a competitor's products, even when they are patented, thus bringing a steady flow of innovations to the marketplace.").

281. The court has explained the distinction this way:

> Although designing or inventing around patents to make new inventions is encouraged, piracy is not. Thus, where an infringer, instead of inventing around a patent by making a substantial change, merely makes an insubstantial change, essentially misappropriating or even "stealing" the patented invention, infringement may lie under the doctrine of equivalents.

London v. Carson Pirie Scott & Co., 946 F.2d 1534, 1538 (Fed. Cir. 1991).

282. On the relationship between the doctrine of equivalents and inventing around, see Paul N. Katz, *The Doctrine of Equivalents and Its Impact on "Designing Around,"* 4 FED. CIR. B.J. 315, 315-39 (1994). One reason to allow inventing around is that otherwise there might be a perverse incentive to seek out nonobvious solutions to problems when obvious solutions were possible. Patent law would be more difficult to administer if a patent's validity depended on whether there were *any* obvious solutions to the relevant problem, rather than on whether the particular means of solving the problem was nonobvious.

283. Louis Kaplow, *The Patent-Antitrust Intersection: A Reappraisal*, 97 HARV. L. REV. 1813, 1869 (1984).

284. *See, e.g.*, Donald F. Turner, *The Patent System and Competitive Policy*, 44 N.Y.U. L. REV. 450, 455 (1969). A potential counterargument is that funds allocated to inventing around would not necessarily have been allocated to other research-and-development activities. If research and development have large social benefits that inventors are unable to internalize, inventing around conceivably could on average have benefits larger than costs. Encouraging inventing around, however, is a crude means of encouraging research and development.

285. Kaplow, *supra* note 283, at 1870.

Despite theoretical models suggesting that the possibility of licensing should make inventing around rare,[286] empirical evidence indicates that inventing around is widespread[287] and costly.[288] A prize system, at least on initial inspection, promises to ameliorate the problem. If a patent is placed in the public domain, then there will be no incentive to invent around it. To be sure, there will remain an incentive to invest research funds in possible improvements, for example in pharmaceutical products that have fewer side effects or that serve different segments of the population, though the incentive will be less than before. Private incentives should be aligned more closely with social ones, as inventors will pursue research if and only if it improves upon what is already in the public domain.

There are, however, two significant concerns. First, a prize system may increase the incentive to invent around a patent that has not been placed in the public domain—for example, because the original inventor decided not to opt into an optional prize system. If a prize system pays an inventor more than the monopoly profit that she could earn on an invention,[289] as suggested by some of the reward proposals, the incentive to invent around will be greater than it otherwise would have been. Anticipating this outcome, the original inventor may invest less in research, anticipating a reduction in appropriable benefits from innovating. As Kremer has noted, allowing the original inventor to opt for the prize system once the substitute product is invented may provide one solution.[290] The solution is an imperfect one, though no worse than the existing patent system. The creation of a perfect substitute, for example, would mean that the original and subsequent inventors each would receive half of the prize. Thus, wasteful inventing around will still occur, and this inventing around will decrease ex ante incentives to innovate.

An alternative, though messier, solution would be to provide smaller or no rewards for those who have invented around. For example, if the inventor of a perfect substitute sought a reward, no reward would be appropriate, because there would be no social benefit from the research. Although placement of the perfect substitute into

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286. *See, e.g.*, Martin J. Adelman, *The Supreme Court, Market Structure, and Innovation:* Chakrabarty, Rohm, *and* Haas, 27 ANTITRUST BULL. 457, 464 (1982).

287. *See* Edwin Mansfield et al., *Imitation Costs and Patents: An Empirical Study*, 91 ECON. J. 907, 913 (1981).

288. For figures on the costs of inventing around, see Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development*, *in* 3 BROOKINGS PAPERS ON ECONOMIC ACTIVITY 783, 807-12 (Martin N. Baily & Clifford Winston eds., 1987).

289. Or, more accurately in this context, more than the *duopoly* profit that the inventor would earn, since the inventor will have to compete with the original patent holder.

290. *See* Kremer, *supra* note 21, at 1154-55; *supra* text accompanying notes 147-49.

the public domain would lower prices for consumers and eliminate deadweight loss, it would hurt the original inventor and thus decrease that inventor's innovation incentives, which the patent system presumably optimized. A partial substitute, such as a product that was better in some ways than the original, would receive some reward, but a lesser one. Assuming it is possible to calibrate rewards based on such criteria, the prize system at least will not increase incentives to invent around, though many inventors presumably would respond by not opting out of the patent system, if given the choice. The patent prize proposals discussed in Part I, however, would need modification to allow such calibration.

Second, while placing a product in the public domain eliminates the incentive to invent around, it may lead to inefficient excessive research into improvements on the initial invention. We have come full circle back to the common pool problem and to the observation that if an improvement on the initial invention is promising, there may be excessive research that dissipates the rent achievable from such improvements.[291] Patents allow the monopolist to limit the amount of subsequent innovation, but placing patents in the public domain eliminates this ability. Conceivably, the inefficiency from excessive investment in improvements could offset or even swamp the efficiency benefits of the prize system for a particular innovation. The only proposal that does not suffer from this problem is Lichtman's coupon scheme, though we have seen that this approach may be inferior to patent buyouts in some instances.[292] Thus, the common pool problem once again indicates that an ideal prize system would lead to patent buyouts in some instances and coupon schemes in others. And even where a patent buyout is optimal, an ideal patent buyout scheme would calibrate prizes so that any economic loss from excessive investment is deducted from prizes.

C. The Adverse Selection Problem

While the common pool problem affects both patent and prize systems, the creation of a regime in which inventors may choose between patent protection and prizes, as the prize system proposals reviewed earlier suggest,[293] presents a new problem—that of adverse

291. *See supra* text accompanying note 244.

292. *See supra* notes 176-78 and accompanying text.

293. All of the proposals discussed in Part I are opt-in, though Shavell and van Ypersele note that a mandatory system might have advantages over an optional one. *See* Shavell & van Ypersele, *supra* note 19, at 539-40; *supra* notes 90-92 and accompanying text.

selection.[294] Inventors presumably will choose the system that will offer them the highest returns, also taking into account the relative uncertainties of remuneration in both systems.[295] Inventors may choose prizes because they believe, possibly on the basis of information not available to the administrators of the prize system, that their returns from the prize system will be unusually high relative to the patent system. The result is similar to what George Akerlof observed of the used car market, that the selection effect will produce a high number of "lemons."[296] The following sections explore two ways that a prize application might be a lemon.

1. Prizes for Commercially Unattractive Inventions

The most obvious aspect of the adverse selection problem is that prizes might be paid to inventors with commercially unattractive inventions.[297] As with all adverse selection problems, the greater the degree of asymmetric information, the more severe the problem.[298] To

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294. "Adverse selection" is a phrase common in the insurance context. *See* KENNETH S. ABRAHAM, DISTRIBUTING RISK: INSURANCE, LEGAL THEORY, AND PUBLIC POLICY 15 (1986) (defining "adverse selection" as "the process by which low-risk insureds tend to purchase less coverage, and high-risk insureds tend to purchase more coverage than they would if prices were more accurate").

295. Uncertainty in a prize system would not be fatal to it, though a high variance of outcomes might reduce the effective prize to inventors. *See infra* notes 386-87 and accompanying text.

296. George A. Akerlof, *The Market for 'Lemons': Quality Uncertainty and the Market Mechanism*, 84 Q.J. ECON. 488, 489-90 (1970).

297. Commercially unattractive inventions are not inherently problematic, if the inventions have public good properties that would prevent them from being privately exploited. One criticism of current U.S. technology policy is that it sometimes allows private parties to both receive government grants and then obtain patents on the resulting products. *See* Bayh-Dole Act, Pub. L. No. 96-517, § 6(a), 94 Stat. 3015, 3018-27 (1980) (codified as amended at 35 U.S.C. §§ 200-11 (2000)) (allowing businesses to obtain patents on government-sponsored research); *see also* Peter S. Arno & Michael H. Davis, *Why Don't We Enforce Existing Drug Price Controls? The Unrecognized and Unenforced Reasonable Pricing Requirements Imposed upon Patents Deriving in Whole or in Part from Federally Funded Research*, 75 TUL. L. REV. 631 (2001) (urging enforcement of legal requirements that inventions supported by federal funding be sold at reasonable prices); Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663 (1996) (arguing that allowing patentability of government-sponsored research may interfere with technological progress). In theory, such a regime can be justifiable if the research can be partly exploited by private parties, but government grants are needed to complement already existing private research incentives to overcome public good problems. *See, e.g.*, Richard E. Romano, *Aspects of R&D Subsidization*, 104 Q.J. ECON. 863, 867-72 (1989) (developing a theoretical model in which the government sometimes increases social welfare by subsidizing private investment leading to grants of patents).

298. On the connection between adverse selection and asymmetric information in the securities context, see Bernard S. Black, *The Legal and Institutional Preconditions for Strong Securities Markets*, 48 UCLA L. REV. 781, 804-05 (2001).

consider an extreme example, suppose that the inventor of a drug has private information that the drug will alleviate the symptoms it targets for only the first year of use, but this information has not been made public.[299] Because the administrator of the prize system does not have access to this information, the prize awarded presumably will be higher than it otherwise would be, given the importance of this information. It is possible that the effect of high prizes will be benign, if they simply provide generally increased incentives to engage in research-and-development activities. The excess prizes, though, consume social resources that might be targeted more effectively. Moreover, anticipation of such high prizes might conceivably distort research investment, with funds channeled toward areas in which possession of asymmetric information is relatively likely.

There are two basic strategies that a prize system can use to address the problem. The first is to take it into account by offering lower prizes than otherwise would be given. Just as buyers of used cars implicitly take the lemons problem into account by recognizing that used cars often have more problems than comparably aged cars not sold on the used car market,[300] the administrator might give lower prizes based on the possibility of asymmetric information than it otherwise would give. Though Shavell and van Ypersele do not discuss the adverse selection problem directly, their model implicitly takes it into account, awarding smaller prizes than they would otherwise because inventors' asymmetric knowledge about demand will make those with poor prospects more likely to take the prize.[301] Similarly, the government could examine market test results skeptically in calculating a patent buyout price in the Guell and Fischbaum scheme. Kremer's approach, meanwhile, automatically would result in lower prizes, because auction bidders, like used car buyers, would recognize the problem of adverse selection,[302] though if competitors have better information than the government, the depression might be relatively minimal. Lowering rewards would be more difficult for Lichtman's coupon scheme, which requires that the coupons be great enough to

299. This may be unlikely given rigorous FDA disclosure requirements. *See* 21 U.S.C. § 355(b)(1)(A) (1994) (requiring "full reports of investigations which have been made to show whether or not such drug is safe for use and whether such drug is effective in use").

300. For an explanation of the lemons problem concluding that "consumers do not overpay," see Timothy J. Muris, California Dental Association v. Federal Trade Commission: *The Revenge of Footnote 17*, 8 SUP. CT. ECON. REV. 265, 288 (2000).

301. *See* Shavell & van Ypersele, *supra* note 19, at 539; *supra* text accompanying notes 88-89.

302. In addition, Kremer emphasizes that the markup would lessen the adverse selection problem by giving even inventors with commercializable inventions incentives to accept prizes. *See* Kremer, *supra* note 21, at 1149-50; *supra* text accompanying notes 120-21.

enable low-valuing users to purchase the product and to incentivize the monopolist to offer it at a low price.

The second strategy is to wait for more information before awarding a prize. This approach is integral to Shavell and van Ypersele's suggestion that the government might adjust rewards on an annual basis, basing adjustments on revised calculations of demand from actual sales data.[303] Waiting would be more difficult with the Guell and Fischbaum approach, since eventually the market test must end so that actual sales of the drug can begin. As Kremer describes his proposal, money would be paid immediately after the auction, thus eliminating the benefit of delay. Finally, Lichtman's proposal does not allow for delay. The government must be able to determine in advance the size of coupons and to whom they should be awarded. Similarly, in the suggested modification to his proposal in which the government would agree with the patent holder on a set price,[304] the government must be able to calculate this price in advance.

In making these comparisons, my intention is not merely to add to the dizzying list of considerations needed to compare prize system proposals. Rather, it is to show that the list *is* dizzying, as would be any final empirical comparison of different proposals, even taking into account only the adverse selection consideration addressed in this section of the Article. The analysis also suggests that sometimes it might be worthwhile to use some combination of approaches. For example, Kremer's proposal might be modified so that the high bid is just one factor, along with the success of the product once placed in the public domain, used to determine compensation for inventors. Similarly, the government administering a coupon scheme might allow the patent holder to set its own price, promising to pay an eventual cash prize dependent on the results achieved. These considerations suggest again that there will be a benefit to flexibility in administering a prize system, a benefit that we ultimately will balance against any costs of flexibility.[305]

2. Unnecessary Prizes

This reasoning suggests that we should be wary when someone chooses a prize over a patent because that choice may indicate that the inventor did not believe that patent protection would be valuable. Even if the government can address this problem by estimating the value of patents, some prize applicants might have decided not to price

303. *See* Shavell & van Ypersele, *supra* note 19, at 541-42; *supra* text accompanying note 96.

304. *See supra* notes 178-81 and accompanying text.

305. *See infra* Part III.A.

their products monopolistically even if the patents were valuable. In the extreme case, a patent holder might have released the patent to the public domain even in the absence of a prize system; in a less extreme case, a patent holder might license a patent at a relatively low cost. A patent holder might do this for reputational reasons—for example, because the patent owner might expect criticism for fully exploiting its patent.[306] Some such patent holders, however, might apply for prizes anyway, meaning that tax dollars will be spent on what otherwise would not have been a government-sponsored program. Similarly, some patents may never be licensed even if they represent true advances, and holders of such patents might request prizes even though they would not have exploited the patents.[307]

The flip side of the dilemma is that a company might release a patent to the public domain because doing so will not prevent the company from achieving monopolistic pricing. If the company had a patent on a complementary product as well, the company might decide to exploit the combined set of patents through high prices for one rather than for both.[308] Giving a prize to the company for releasing the patent that it otherwise would not have exploited may not be necessary. Similarly, a patent holder might be a natural monopoly producer of the product it has patented,[309] or it might be able to

306. This is hardly naïve speculation. Some pharmaceutical companies, for example, have allowed their patents to be used for free in third-world countries without payment. *See, e.g.*, Helene Cooper et al., *Patents Pending: AIDS Epidemic Traps Drug Firms in a Vise: Treatment vs. Profits*, WALL ST. J., Mar. 2, 2001, at A1 (discussing drug companies' dilemma whether to allow generic copies of their drugs in poor countries); Rachel L. Swarns, *Drug Makers Drop South Africa Suit over AIDS Medicine*, N.Y. TIMES, Apr. 20, 2001, at A1 (reporting that the pharmaceutical industry bowed to "mounting public pressure" by dropping a lawsuit that sought to prevent uncompensated use of patents on AIDS drugs). For conflicting editorial views on patent enforcement by drug companies in poor countries, compare *South Africa's AIDS Victory*, N.Y. TIMES, Apr. 20, 2001, at A18 (cautioning drug companies "not to start new efforts to block access to cheaper drugs" in poor nations), with Robert M. Goldberg, *Fight AIDS with Reason, Not Rhetoric*, WALL ST. J., Apr. 23, 2001, at A22 (asserting that the South African settlement "is part of a strategy to impose price controls and limit patent protection" that will "ensure that this current generation of AIDS drugs is the only one we have for a long time to come").

307. For an explanation of why patent licensing rates are likely quite low, see Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1503-08 (2001).

308. This observation is central to Kremer's concern that companies might be overcompensated for complementary patents under his system. *See* Kremer, *supra* note 21, at 1155-57; *supra* text accompanying notes 145-46.

309. A natural monopoly is "[a] monopoly in which the relation between industry demand and cost structure makes it possible for only one firm to exist in the industry." EKELUND & TOLLISON, *supra* note 30, at 255. Some commentators and courts have analogized all patents to natural monopolies, urging that patent holders be regulated in a manner similar to the price regulation techniques used for utilities. *See generally* John W. Schlicher, *If Economic Welfare Is the Goal, Will Economic Analysis Redefine Patent Law?*, J. PROPRIETARY RTS., June 1992, at 12, 15-16 (discussing such theories). If a patent were placed in the public domain, however, there

credibly threaten potential entrants into a market with either predatory pricing[310] or litigation.[311] If so, then the patent holder surrenders nothing by releasing the product into the public domain, and paying the patent holder for doing so will fail to reduce deadweight loss.

The welfare consequences of awarding patent prizes to those who have not fully exploited their patents are equivocal. It may make sense to award prizes for innovations that a company would decide not to exploit for publicity reasons, as a way of ensuring that there are continued incentives for the development of research into such areas. On the other hand, the positive reputational effect of releasing a product into the public domain without a prize may be sufficient by itself to stimulate research in some cases, so the government may end up subsidizing some research that would have been performed even in the absence of the prize system. The welfare consequences of paying prizes in the case of the inevitable monopolist are less equivocal. It is possible that the prizes will provide companies an additional incentive to invest in research and development,[312] but such prizes will be of no help in limiting deadweight loss. Moreover, companies that have nothing to lose from placing a patent in the public domain will be more likely than others to seek prizes.

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might or might not be a natural monopoly for the corresponding product, depending largely on the startup costs for building a plant to produce the product.

310. Whether predatory pricing is in fact a viable strategy for avoiding competition is a much-debated question in the economics literature. *Compare* JOHN R. LOTT, JR., ARE PREDATORY COMMITMENTS CREDIBLE?: WHO [sic] SHOULD THE COURTS BELIEVE? 18-60 (1999) (arguing with empirical evidence that profit-maximizing firms rarely engage in predatory pricing), *with* Peter H. Huang, *Still Preying on Strategic Reputation Models of Predation*, 3 GREEN BAG 2D 437, 442 (2000) (reviewing LOTT, *supra*) (citing empirical analysis supporting the existence of predatory pricing). A significant early work offering a model in which predatory pricing might occur is Paul Milgrom & John Roberts, *Predation, Reputation, and Entry Deterrence*, 27 J. ECON. THEORY 280, 284-302 (1982) (offering a model in which predatory pricing might occur).

311. Intimidation through litigation is rarely sanctioned under the antitrust laws, as a result of the *Noerr-Pennington* doctrine, unless the litigation is a "sham." *See* Eastern R.R. Presidents Conference v. Noerr Motor Freight, Inc., 365 U.S. 127, 144-45 (1961) (finding action by railroad companies to obtain favorable governmental action not illegal under antitrust laws); United Mine Workers v. Pennington, 381 U.S. 657, 670 (1965) (holding that "joint efforts to influence public officials" are not illegal even if "intended to eliminate competition"); James B. Perrine, Comment, *Defining the "Sham Litigation" Exception to the* Noerr-Pennington *Antitrust Immunity Doctrine: An Analysis of the* Professional Real Estate Investors v. Columbia Pictures Industries *Decision*, 46 ALA. L. REV. 815 *passim* (1995) (exploring the "sham" exception to the doctrine).

312. Other schemes, such as tax breaks for research-and-development expenses, might he better targeted. *See* Stephen A. Jones, Note, *The Danforth-Baucus Proposal to Restructure the Research and Development Tax Credit: Providing a More Reliable Incentive for Commercial Experimentation*, 42 TAX LAW. 1089, 1093-1100 (1989) (considering the strengths and weaknesses of research-and-development tax credits).

The first three proposals discussed in Part I are not directly responsive to the problem. The Guell and Fischbaum proposal, for example, would base a prize on monopoly profits extrapolated from a test market, but the prize recipient would be able to continue to charge monopoly prices in other markets. In the Kremer market proposal, a bidder may bid a great deal for monopoly rights, which would allow exclusion of the original patent holder, even if the original patent holder would continue to dominate the market if the product were randomized to the public domain. Even the Shavell and van Ypersele proposal, while considering subsequent sales data, is based on calculation of the demand curve, rather than the supply curve. To address the problem, all of these proposals would have to be modified to allow some ex post check that the product's placement into the public domain has had a meaningful effect.

The problem, though, would not affect the Lichtman proposal. After all, the Lichtman proposal imagines that a single seller would continue to sell the product. If a single producer has a natural monopoly, in order to eliminate deadweight loss the government must provide appropriate incentives to the producer, rather than use a mechanism that would allow others to join the market. Thus, ironically, Lichtman's proposal, which was least flexible in addressing the adverse selection problem discussed in the previous section, is best insulated from the adverse selection problem addressed in this section. This observation underscores the difficulty of identifying a single best proposal. Moreover, the severity of the problem discussed here might vary from market to market, applicable more to industries with high fixed costs and to products with high marginal costs of production. This variability emphasizes again the virtues of a system that encourages different approaches depending on which is the most efficient in the particular context.

D. Costs of a Prize System

A prize system cannot be assessed merely by examining the prizes ultimately rewarded and determining whether those awards will tend to encourage or discourage innovative activity. The costs of operating any prize system must also be considered. The government will incur costs from paying prizes, of course, but it also may incur costs in tbe administration of the prize system. Indirect costs incurred by inventors are also relevant—including the costs of any litigation that results from disputes over prizes, as well as investors' expenditures on political rent-seeking activities. The patent system, of course, may result in costs in some of these categories, and prize

system costs will be additional to the patent system's unless the prize system lessens the costs of the patent system. This section considers the implications of these various types of costs for a prize system.

1. Financing Costs

For government prizes to substitute for monopoly power in rewarding innovation, the government must pay money for innovations. An immediate objection might be that it is naïve to think that the government would devote a sufficient amount of money to a patent prize system for it to make any difference.[313] Calandrillo responds to such critiques by arguing that the government could raise sufficient funds if Congress desired.[314] A different response would be that a smaller federal program might well produce more in benefits per dollar than a larger program. This is so for two reasons. First, a relatively small program could be used to relieve the burden associated with the patents that impose the greatest loss per dollar of monopoly profit. Second, the last marginal dollar in profit that a monopolist receives imposes more of a deadweight loss than any earlier dollar,[315] so a proposal seeking to lower prices partly, but not completely to marginal cost, might produce almost as much gain as one seeking to eliminate deadweight loss altogether. Of course, only a very large federal program could produce revolutionary changes, but this would be an argument against the proposal only if small-scale implementation were infeasible.

Assuming that the program is of optimal size, it might appear that the government will necessarily improve social welfare if a prize program is sufficiently accurate. When giving putative patent holders what would have been their monopoly profits, the government saves consumers this amount, plus what would have been deadweight loss to boot. A dollar spent achieves more than a dollar in benefits, thus seeming to pass a rudimentary cost-benefit analysis.[316] The problem

313. *Cf.* Robert M. Hurt & Robert M. Schuchman, *The Economic Rationale of Copyright*, 56 AM. ECON. REV. 421, 436-37 (1966) (comments of Robert W. Frase) (arguing that it would be impossible to raise sufficient funds for a copyright prize system).

314. Calandrillo, *supra* note 20, at 344-45.

315. For an explanation, see Ian Ayres, *Pushing the Envelope: Antitrust Implications of the Envelope Theorem*, 17 MISS. C. L. REV. 21, 22-24 (1996).

316. Some commentators might argue that because patents on products like drugs involve health, cost-benefit analysis is an inappropriate, commodificationist tool. *See, e.g.*, ELIZABETH ANDERSON, VALUE IN ETHICS AND ECONOMICS 190-95 (1993). Several scholars in recent years have defended cost-benefit analysis against this line of critique. *See* Matthew Adler, *Incommensurability and Cost-Benefit Analysis*, 146 U. PA. L. REV. 1371, 1376-77, 1383-89 (1998); Matthew D. Adler & Eric A. Posner, *Rethinking Cost-Benefit Analysis*, 109 YALE L.J. 165, 194-225 (1999); Lewis A. Kornhauser, *On Justifying Cost-Benefit Analysis*, 29 J. LEGAL STUD. 1037,

with this analysis is that, under the traditional economic wisdom,[317] a proper evaluation of a social program should count a dollar as more than a dollar, because government funds cost money to raise. Taxation causes economic distortions.[318] Taxing apples will lead consumers to eat fewer apples and more oranges; taxing income may lead taxed entities to make less of it.[319] In addition, greater levels of taxation lead to increased expenditures on tax avoidance, for example, by hiring of accountants and tax lawyers.[320] Governments can finance expenditures with deficit spending instead of taxation, but this financing has its own problems.[321] The various means of fundraising do not obviate the need to consider the distortionary cost of each additional dollar in federal spending.

The distortionary effect of taxation is integral to Lichtman's analysis. Recall that Lichtman showed how a coupon scheme might achieve the same decrease in deadweight loss as a patent buyout at a fraction of the cost.[322] One might ask, though, why the difference in costs matters. The reduced costs to the government in Lichtman's scheme come at the expense of consumers, who provide the rest of the funds needed to make up what would have been monopoly profits, so

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1045-51 (2000); *see also* Cass R. Sunstein, *Cognition and Cost-Benefit Analysis*, 29 J. LEGAL STUD. 1059, 1076-77 (2000) (arguing that cost-benefit analysis is best justified as a tool for helping to overcome biases due to cognitive heuristics).

317. Concern with the relevance of the distortionary effect of taxation for funding of public goods dates at least to ARTHUR C. PIGOU, A STUDY IN PUBLIC FINANCE 33-34 (3d ed. 1947). Some of the most important subsequent work, however, ignored the problem. Most notably, Paul Samuelson, simply assumed a lump-sum tax that would impose no economic distortion. *Cf.* Paul A. Samuelson, *The Pure Theory of Public Expenditure*, 36 REV. ECON. & STAT. 387, 388 (1954).

318. A policy-induced economic distortion is a government policy that causes individuals to alter what would otherwise be their preferred behavior. For a useful vocabulary and typology of distortions, see Richard S. Markovits, *The Allocative Efficiency of Shifting from a "Negligence" System to a "Strict-Liability" Regime in Our Highly-Pareto-Imperfect Economy: A Partial and Preliminary Third-Best-Allocative-Efficiency Analysis*, 73 CHI.-KENT L. REV. 11, 30-32 (1998).

319. A consumption tax causes distortions in individuals' allocation of time between work and leisure, while an income tax also distorts individuals' allocation of income between savings and consumption. *See* Daniel N. Shaviro, *An Efficiency Analysis of Realization and Recognition Rules Under the Federal Income Tax*, 48 TAX L. REV. 1, 24-25, 25 n.119 (1992) (concluding that a consumption tax may be less distortionary than an income tax "if the work-leisure boundary is less elastic than the savings-consumption boundary").

320. *See, e.g.*, DAVID F. BRADFORD, UNTANGLING THE INCOME TAX 174-75 (1986) (emphasizing the high costs of such tax avoidance). Higher taxes also might induce more tax evasion. *See, e.g.*, Nehemiah Friedland et al., *A Simulation Study of Income Tax Evasion*, 10 J. PUB. ECON. 107, 111, 114 tbl.3 (1978) (offering a simulation in which higher tax rates produce more tax evasion). *See gencrally* FRANK A. COWELL, CHEATING THE GOVERNMENT: THE ECONOMICS OF EVASION 72-73 (1990).

321. A seminal article exploring the benefits and costs of deficit financing is Robert J. Barro, *On the Determination of the Public Debt*, 87 J. POL. ECON. 940 (1979).

322. *See* Lichtman, *supra* note 22, at 135; *see also supra* text accompanying notes 176-78 (arguing that a coupon scheme sometimes might be more expensive than a patent buyout).

the total amount being paid by the government and consumers remains the same. The answer is that the government's expenses are of greater concern because of tax distortions. Lichtman guesses that the deadweight loss attributable to tax collection is thirty cents on the dollar.[323] Because the deadweight loss from monopoly under his assumptions would be fifty cents on the dollar, a patent buyout would save twenty cents per dollar relative to the patent system, but a properly implemented consumer subsidy of only about four cents per dollar.[324] The precise estimates that he uses are not relevant. As long as there is some distortionary effect of taxation, a program that results in less government expenditure, even at the expense of consumer expenditure, should be preferred.

A recent literature, however, emphasizes that while the tax system as a whole is distortionary, some increases in taxes may not be.[325] One reason is that while taxation may distort relative prices, once an economy is already distorted by taxes, the adoption of a new tax conceivably might bring relative prices more closely into line.[326] If, for a simple example, the investment tax credit is distortionary, then repeal of the credit may both raise revenue and improve efficiency.[327] This analysis, however, is presumably relevant only if a proposal for a prize system were accompanied by a specific tax proposal. The second reason is generally applicable to income taxes. It is that an increase in income taxes may lead workers to work more rather than less,[328] if the income effect of the tax (the tendency of workers to work more because

323. Lichtman, *supra* note 22, at 133 & n.26 (citing Barton H. Thompson, Jr., *The Endangered Species Act: A Case Study in Takings & Incentives*, 49 STAN. L. REV. 305, 355 (1997) (estimating the deadweight loss from a marginal increase in taxes to be between seventeen and fifty-six cents per dollar raised)). Thompson in turn obtains these numbers from Charles L. Ballard et al., *General Equilibrium Computations of the Marginal Welfare Costs of Taxes in the United States*, 75 AM. ECON. REV. 128, 136 (1985). Later work by Ballard, however, has called these conclusions into question. *See infra* notes 325-28 and accompanying text.

324. Lichtman, *supra* note 22, at 135 & tbl.5.

325. For an overview of this literature, see Charles L. Ballard & Don Fullerton, *Distortionary Taxes and the Provision of Public Goods*, J. ECON. PERSPECTIVES, Summer 1992, at 117, 124-25, 129.

326. *See, e.g.*, Jean Drèze & Nicholas Stern, *Policy Reform, Shadow Prices, and Market Prices*, 42 J. PUB. ECON. 1, 43 (1990).

327. *See* Ballard & Fullerton, *supra* note 325, at 129 (citing Don Fullerton & Yolanda K. Henderson, *The Marginal Excess Burden of Different Capital Tax Instruments*, 71 REV. ECON. & STAT. 435, 441 (1989)). Another example is that of "a Pigouvian, externality-correcting tax." *Id.* (citing Charles L. Ballard & Steven G. Medema, The Marginal Efficiency Effects of Taxes and Subsidies in the Presence of Externalities: A Computational General Equilibrium Approach (1991) (unpublished manuscript, on file with Michigan State University)).

328. *See* Joseph E. Stiglitz & Partha S. Dasgupta, *Differential Taxation, Public Goods, and Economic Efficiency*, 38 REV. ECON. STUD. 151, 159 (1971); *see also* Ballard & Fullerton, *supra* note 325, at 122-24.

the lower wage decreases demand for normal goods, including leisure time) outweighs the substitution effect (the tendency of workers to work less because the tax decreases the opportunity cost of leisure).[329] Intuitively, a worker who is paid less may work more to maintain a given standard of living.[330]

For at least two reasons, the recent literature should not encourage complacency about the distortionary effects of taxation. First, the literature generally ignores the tax system's administrative and compliance costs,[331] the latter of which, in particular, might plausibly be impacted by tax rate increases. Second, the literature does not explicitly consider that the provision of a public good itself may have a negative effect on labor supply. People care about their income because their level of income will affect their ability to purchase goods. If a number of goods suddenly become free (or much cheaper), income will be less significant. To take a reductionist example, suppose the only two goods in the economy were food and prescription drugs. If prescription drugs suddenly became free, then there would be a reduced incentive to work, because the money previously spent on drugs might make a smaller contribution to utility if spent entirely in the food category. How strong this effect is in a real economy depends on the context.[332]

In the absence of a consensus that in our actual tax system increases in taxes will decrease tax distortions, it would be hazardous to disregard the concern about the potentially distortionary effect of increased income taxes. It at least seems reasonable that government

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329. On income and substitution effects, see NICHOLSON, *supra* note 76, at 135-37. For a review of the literature suggesting tbat the elasticity of labor supply may be negative for certain groups of earners, see Gary Burtless, *The Work Response to a Guaranteed Income: A Survey of Experimental Evidence, in* LESSONS FROM THE INCOME MAINTENANCE EXPERIMENTS 22, 34 tbl.3, 35-38 (Alicia H. Munnell ed., 1987).

330. Whether this is true for a particular worker may depend on the current income of that worker, if the labor supply curve is "backward-bending." *See generally* GEORGE J. BORJAS, LABOR ECONOMICS 43, 43-46 (1996) (explaining backward-bending labor supply curves).

331. *See* Ballard & Fullerton, *supra* note 325, at 118-19 ("Although tbese costs are doubtless important, they have generally been ignored by the economists studying the marginal cost of public funds since the 1970s.").

332. A relevant part of the context is whether individuals care more about their ability to purchase goods because these goods are inherently valuable to them or because these goods are valuable to them primarily because others possess them. Robert H. Frank has argued that the answer depends on the goods at issue and has used the terms "nonpositional goods" (in which category he includes education and health care) and "positional goods" to refer to the respective types. *See, e.g.*, ROBERT H. FRANK, LUXURY FEVER: WHY MONEY FAILS TO SATISFY IN AN ERA OF EXCESS *passim* (1999); *see also* Robert H. Frank & Cass R. Sunstein, *Cost-Benefit Analysis and Relative Position*, 68 U. CHI. L. REV. 323, 370-71 (2001) (exploring the significance of the distinction for cost-benefit analysis). Frank's identification of health care as a nonpositional good suggests that free distribution of drugs would not have as great a negative effect on the supply of labor as it would if it were a positional good.

programs costing less should, all else being equal, be preferred to government programs costing more. One possible response to the distortionary effect might be to tax specifically those who benefit from a patent prize system in a particular context. As Louis Kaplow shows, if a public good is funded by a tax allocated to the benefit each individual receives from it, then there is no tax distortion from it.[333] Of course, if a patent buyout were funded by an excise tax, the tax would defeat the purpose of the buyout, raising the price of the product back to the monopoly price.[334] On the other hand, the government might fund a patent prize system by relying on proxies indicating who would benefit from it. For example, to fund a patent prize system designed to buy out patents on agricultural technology, the government might tax all farmers, regardless of whether they subsequently decided to purchase products containing the technology. Such taxes often will be politically unattractive, however, because in the absence of excellent proxies, they will result in heavy levies being imposed on some individuals who do not benefit at all.

Prize systems thus ordinarily would likely be funded from general tax receipts, with some presumed tax distortion effect. In comparing any particular prize system proposal, however, an individualized evaluation of any redistributive benefit from the proposal should accompany an analysis of the distortionary tax effect. Louis Kaplow observes that a prime reason that income taxes are distortionary relative to a hypothetical lump sum tax is that they are progressive.[335] "But if this assumption is to be made," Kaplow argues, "the distributive benefit of the more progressive tax/expenditure

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333. Kaplow explains this intuition by imagining an individual for whom a public goods program produces benefits exactly equal to one percent of income, where the program is funded by a one percent tax:

> For each additional dollar an individual might earn, he will have one cent less than otherwise available for private consumption, 69 cents instead of 70 cents. However, the individual will benefit in an amount worth one additional cent due to the availability of the public good, raising his aggregate marginal benefit from earning a dollar back to 70 cents. *That is, his net utility benefit from earning an additional dollar will be precisely what it was before--without the public good and the tax adjustment.* Because each individual's net benefit from any level of labor effort is thus unchanged, labor supply will be unaffected, and each individual's utility will he the same as it was before.

Louis Kaplow, *The Optimal Supply of Public Goods and the Distortionary Cost of Taxation*, 49 NAT'L TAX J., 513, 515 (1996).

334. *See* Shavell & van Ypersele, *supra* note 19, at 544 (noting that "commodity taxation . . . is essentially equivalent to granting intellectual property rights"). The patent buyout program must pay the patent holder monopoly profits. Thus, if the program is to be funded by purchases of the product, each purchaser must pay monopoly profits divided by the number of purchasers. The number of purchasers will be the same as the equilihrium under monopoly, since the next marginal potential consumer would not be willing to pay the excise tax required.

335. Kaplow, *supra* note 333, at 521.

system should be included in the final account."[336] Even apart from the point that redistributive benefits should be counted at least insofar as they offset distortionary costs,[337] redistributive benefits are potentially relevant to an assessment of a patent prize system. Although many commentators urge that redistribution should generally be accomplished through the income tax,[338] patent prize proposals may accomplish redistribution other than Robin Hood reallocation of resources from the rich to the poor. For example, a patent prize system for prescription drugs might redistribute from the healthy to the sick, and it might accomplish this goal more efficiently than could an alternative tax provision aimed at this goal.[339]

Two general points, potentially offsetting, emerge from the above analysis. First, Lichtman's observation that cheaper means of eliminating deadweight loss should be preferred is probably a useful generalization, but with the awareness that the importance of the effect can be exaggerated. Second, more expensive alternatives nonetheless should be considered if they produce redistributive benefits. Even if a buyout program were eight times more expensive than a coupon scheme (and I have shown that this will be unlikely),[340] it might be desirable for the government to adopt the costlier proposal. The difference in social cost, which depends on the distortionary effect on taxation, will likely be considerably less in any event than the difference in the government's costs. Of course, redistributive benefits may vary from program to program, or even patent to patent. A patent buyout for a "lifestyle drug" might be viewed as having neutral or even negative redistributive consequences.[341] Once again, these

336. *Id.*

337. In a separate work, written with Steven Shavell, Kaplow has emphasized the importance of concerns about the distribution of income to welfare economics. *See* Louis Kaplow & Steven Shavell, *Fairness Versus Welfare*, 114 HARV. L. REV. 961, 989-98 (2001).

338. *See, e.g., id.* at 993 ("[W]hen legal rules do have distrihutive effects, the effects usually should not be counted as favoring or disfavoring the rules because distributional objectives can often be best accomplished directly, using the income tax and transfer (welfare) programs.").

339. Anne Alstott has analogously argued that institutional constraints on the tax system may make tbe earned income tax credit a less appealing alternative to welfare programs than it might at first appear. *See* Anne L. Alstott, *The Earned Income Tax Credit and the Limitations of Tax-Based Welfare Reform*, 108 HARV. L. REV. 533, 535, 564-89 (1995).

340. *See supra* text accompanying notes 172-78.

341. In the United Kingdom, critics of the National Health Service have argued that it should not devote resources to Xenical, an anti-obesity pill that they claim is a lifestyle drug. *See* Valerie Hannah, *Drug Giant Under Investigation over Side Effects of Cholesterol Pill*, HERALD (Glasgow), Sept. 5, 2001, at 3, *available at* 2001 WL 26585561. Of course, there is considerable debate about which drugs are lifestyle drugs. Dave Hill, *Viagra Nation*, INDEPENDENT (London), July 15, 2001, at 22, *available at* 2001 WL 23539167 (quoting a doctor as saying that calling Viagra a lifestyle drug is "deeply insulting to those men and their partners who find this condition very distressing").

observations suggest skepticism about a one-size-fits-all patent buyout program.

2. Administrative Costs

In addition to paying prizes themselves, the government would need to pay the costs of running the administrative agency overseeing the prize system. Consideration of these costs may seem to make proposals that vest the agency with little discretion more attractive. We have seen, however, that none of the proposals can be implemented in a truly mechanical way, if basic problems are to be overcome. The test market results from Guell and Fischbaum's proposal would need to be considered individually before being extrapolated to other geographical areas and into the future.[342] Shavell and van Ypersele derive a formula, but an administrative agency would be needed to consider an individual patent's contribution to a product.[343] Similarly, in Kremer's proposal, the agency would need to identify complementary products.[344] While Lichtman identifies on an economic chart which consumers should receive coupons, the procedure for identifying these consumers almost surely necessitates great administrative discretion. Finally, if the government agency is to consider many of the factors considered in this part, it is difficult to imagine a statute specifying just the right mechanical procedure to follow.

If the government were to consider adopting a proposal that binds an agency to calculating prizes in some predetermined way, such as one of the ways suggested in Part I, it would presumably be for some reason other than administrative cost. Once bureaucrats are involved in making individualized considerations for particular prize applications, the cost savings from formalizing the overall process seem unlikely to be great. A process that specifies the means by which government officials should consider each of a hundred factors easily could be more expensive than one that orders the officials simply to consider all relevant factors. The empirical comparison is uncertain, of course, but there is little theoretical reason to favor complex mechanical formulas to open-ended decisionmaking on cost grounds. Even if a mechanical formula could be devised, the government agency at least would need some latitude to verify the correctness of data submitted to it, such as industry sales figures used to justify a claim for a large prize, thus reducing the benefits of automation.

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342. *See supra* notes 62-66 and accompanying text.

343. *See supra* notes 101-05 and accompanying text.

344. *See supra* notes 151-52 and accompanying text.

While Congress would surely need to consider the costs of operating an administrative agency to distribute patent rewards, there is little reason to think that some proposals for structuring an agency will be cheaper than others. A government truly intent on reducing costs might offer a fixed allocation to the agency, perhaps even making part of the agency employees' compensation contingent on finishing the job assigned.[345] Perhaps of greater import is the effect of different proposals on the Patent and Trademark Office, whose costs are not trivial,[346] without even considering the cost to firms of prosecuting patents before the Office. Proposals that require applicants to obtain patents before buyouts will not affect the operation of the Office. Proposals, by contrast, that would allow compensation for innovations without demanding receipt of a patent could save the government administrative costs. There would be benefits to requiring prize applicants to obtain patents, particularly verification of nonobviousness and adequacy of disclosure, though the patent administrative system is designed to provide such verification functions only in conjunction with the patent litigation system.[347] For some patents, these benefits would likely be worth the cost in the prize context, while for others they might not be. A patent system that did not require applicants to obtain patents conceivably could result in net administrative cost savings.

3. Litigation Costs

Reasonable people might disagree about how large a prize an applicant should receive, and such disagreement might be resolved through some type of litigation process. For example, an applicant disappointed with a prize might be allowed to sue the agency in federal court,[348] and the agency itself might offer some form of appeals

345. Agencies often miss statutory deadlines. While one commentator has responded by proposing the abolition of such deadlines, *see* Alden F. Abbott, *The Case Against Federal Statutory and Judicial Deadlines: A Cost-Benefit Appraisal*, 39 ADMIN. L. REV. 171, 200-04 (1987), an alternative approach would be to create compensation-based incentives.

346. The Commissioner of Patents and Trademarks recently complained that the PTO's final fiscal year 2000 budget of $871 million was too low. *See Remarks of Q. Todd Dickinson at PTO Day Annual Conference on Patent & Trademark Office Law and Practice*, 82 J. PAT. & TRADEMARK OFF. SOC'Y 219, 226 (2000).

347. *See supra* Part II.A.2 (explaining the importance of having a system for distinguishing valid patents from invalid patents).

348. If the organic statute creating the prize agency did not establish a standard for review, the courts would presumably apply the relatively deferential substantial evidence test in reviewing agency decisions. *See* 5 U.S.C. § 706(2)(E) (1994) (setting forth the "substantial evidence" test); *cf.* Dickinson v. Zurko, 527 U.S. 150, 152 (1999) (requiring the Federal Circuit to

process.[349] Alternatively, a prize system might encourage private whistleblowers to reveal fraud in prize applications.[350] Regardless of the form of the system adopted, the costs of such litigation, including both the cost to the parties and the cost to the executive and judicial branches, are social costs that offset any benefits of the prize system. Whether these costs are worthwhile depends on the benefits litigation offers—for example, in improving the accuracy of the prize system, in preventing excessive rewards based on faulty data, or even in assuring the due process rights of prize applicants.[351]

Because the authors of patent prize proposals have not described whether and what type of litigation over patent prizes would be permitted, comparison of their proposals is difficult. Some may have simply assumed that decisions by the agency charged with granting patents would be so formulaic as to be uncontroversial. We have seen, though, that no patent prize system can be entirely mechanical; judgment calls must be made.[352] Even patent prize systems that provide a formula to be used for calculation of a prize will need factfinders to determine the value of variables to be plugged into the formula. More mechanical proposals, in any event, need not necessarily produce greater litigation than less structured proposals. For example, if a statute implementing Lichtman's coupon proposal gave an agency a lump sum to spend on coupons for prescription drugs, current law would allow little latitude for challenges.[353] A statute permitting litigation over the amount of prizes surely could lead to large litigation costs, but the size of such costs will depend more on the rules governing litigation than on the rules governing prizes.

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evaluate fact-finding by the Patent and Trademark Office using the substantial evidence test rather than the clearly erroneous test used to assess fact-finding by district courts).

349. A model might be the appeals process used by the Social Security Administration. *See* 42 U.S.C. § 405 (2000).

350. The design of a suitable whistleblower system itself is not a simple matter. *See* John C. Coffee, Jr., *Rescuing the Private Attorney General: Why the Model of the Lawyer as Bounty Hunter Is Not Working*, 42 MD. L. REV. 215 (1983) (critiquing the operation of whistleblower programs).

351. I am skeptical of the concern with the due process rights of prize applicants, aside from the formal need for any proposal to pass constitutional muster. The reason for my skepticism is that the dignitary rights of inventors are less important than, say, the dignitary rights of Social Security applicants. *Cf.* Jerry L. Mashaw, *The Supreme Court's Due Process Calculus for Administrative Adjudication in* Matthews v. Eldridge: *Three Factors in Search of a Theory of Value*, 44 U. CHI. L. REV. 28, 49-52 (1976) (criticizing the Supreme Court for not considering the importance of dignitary rights in defining due process).

352. *See, e.g.*, *supra* notes 342-44 and accompanying text.

353. *See, e.g.*, Lincoln v. Vigil, 508 U.S. 182, 193-94 (1993) (holding that the decision on how to spend a lump sum appropriation had been "committed to agency discretion by law" and was therefore not reviewable).

Patent proposals may differ, however, in the extent to which they reduce litigation associated with the existing patent system. If a prize system produces patent buyouts that place patents in the public domain, there ordinarily will be no need for a prize recipient to enforce its patent with infringement litigation.[354] Although a patent buyout system might not substantially reduce litigation in some situations, for example, when only one of several related patents is placed in the public domain, the overall potential savings are considerable.[355] Prize systems that encourage release of information about innovations without requiring acquisition of patents also might reduce litigation, though litigation could ensue should someone else subsequently obtain a patent arguably derivative of the earlier innovation.[356] Proposals that encourage price reduction by patent holders, by contrast, would not necessarily reduce litigation. Consideration of the effects on future litigation therefore adds yet another variable to the mix needed to compare approaches. And again, the optimal solution may depend on the properties of the particular innovation, as some innovations may be less likely than others to produce the type of confusion or ambiguity that would lead to litigation.

4. Rent-Seeking Costs

We have already seen that a patent system can dissipate rents, as potential patent holders compete to win a patent race,[357] and can prevent dissipation of rents by consolidating ownership of improvements on an invention in a single monopolist.[358] In these examples, the "rent" is either the monopoly profit that a patent holder can capture or the social wealth that competitors can capture, and competition tends to erode the benefit. There is another, more familiar type of rent-seeking that can be associated with a patent system or with a prize system: rent-seeking through regulation.[359] Given the possibility of receiving a government benefit, whether a patent or a prize, private companies might invest resources to influence the

354. *See* Calandrillo, *supra* note 20, at 333 (noting criticisms that the patent system, unlike reward systems, produce "litigation and accompanying administrative costs").

355. The average patent infringement case costs an estimated $1.2 million to litigate. *See* Dee Gill, *Defending Your Rights: Protecting Intellectual Property Is Expensive and Often Crucial*, WALL ST. J., Sept. 25, 2000, at 6 (referring to an unidentified "industry survey").

356. Even if unpatented, however, information released would be relevant as prior art to defeat a subsequent patent. *See* 35 U.S.C. § 103(a) (2000) (detailing the prior art requirement).

357. *See supra* Part II.B.1.

358. *See supra* notes 242-44 and accompanying text.

359. For an overview of rent-seeking in general and this form of rent-seeking in particular, see DENNIS C. MUELLER, PUBLIC CHOICE II 229-38 (1989).

government's decision. Such activity in itself is socially wasteful, and it may generate additional waste as government officials compete for such resources or because the rent-seeking activity causes some distortion in the economy—for example, by altering innovation incentives.[360] These costs offset the social benefits of the patent or prize system, and if the costs of a prize system are sufficiently high, they might outweigh the benefits of a prize system relative to a patent system.

The problem of rent-seeking should neither be ignored nor exaggerated. On the former point, as just one example, several studies have shown that political contributions by companies seeking protectionist legislation have a significant effect on legislators' votes.[361] The patent system itself is arguably a good example of the latter point. Considerable resources are expended, of course, on patent prosecution and patent litigation.[362] The relative independence of the Patent and Trademark Office, however, makes direct lobbying unlikely, though industry as a whole may affect the selection of high-ranking agency officials.[363] Similarly, and interestingly, it is rare for a company to lobby Congress to enact legislation extending a patent term, and when such efforts are made, they are at least ostensibly based on the ground that there is some fairness reason for an extension.[364] Given the potential benefits from an extension, this lack

360. *See* James M. Buchanan, *Rent Seeking and Profit Seeking*, *in* TOWARD A THEORY OF THE RENT-SEEKING SOCIETY 3, 12-14 (James M. Buchanan et al. eds., 1980) (discussing these socially costly effects of rent-seeking).

361. *See* ROBERT E. BALDWIN & CHRISTOPHER S. MAGEE, IS TRADE POLICY FOR SALE? CONGRESSIONAL VOTING ON RECENT TRADE BILLS (Nat'l Bureau of Econ. Research Working Paper No. 6376, 1998), *available at* http://papers.nber.org/papers/w6376.pdf; Cletus C. Coughlin, *Domestic Content Legislation: House Voting and the Economics of Regulation*, 23 ECON. INQ. 437 (1985); Suzanne C. Tosini & Edward Tower, *The Textile Bill of 1985: The Determinants of Congressional Voting Patterns*, 54 PUBLIC CHOICE 19 (1987); *see also* MUELLER, *supra* note 359, at 242 (discussing various studies).

362. *See* Gill, *supra* note 355; *see also* Albert F. Bower, *The Independent Inventor: In Which a Practitioner Shares Some Highly Practical Advice for Safeguarding the Products of Intellectual Labor*, DEL. LAW., Mar. 1989, at 24-25 ("A major cost in patenting is incurred in preparing and filing the application, mainly because of the attorney time required to make an adequate disclosure.").

363. Richard L. Revesz, *Specialized Courts and the Administrative Lawmaking System*, 138 U. PA. L. REV. 1111, 1149 (1990) (noting that interest groups may be able to control the selection of officials and judges in relatively specialized agencies and courts).

364. *See, e.g.*, Shailagh Murray, *Senate Mulls Bill to Extend Drug Patents*, WALL ST. J., Aug. 5, 1999, at A3 (noting that proponents of Schering-Ploug's attempt to obtain legislative extension of the patent for Claritin "argue the extensions are only fair, considering delays in the federal approval process for the drugs"); *see also* Charles R. Babcock, *Patent Fight Tests Drug Firm's Clout: Claritin Maker Goes All Out in Congress*, WASH. POST, Oct. 30, 1999, at A1 (noting Schering-Plough chief executive's claim that the company just wants a fair hearing). Critics, of course, will dispute the fairness reason. *See, e.g.*, *Claritin Patent Extension: Don't Be Fooled by*

of activity suggests a perception that Congress ordinarily will not grant one, probably because legislators view the patent system as the exclusive means of obtaining monopoly power in exchange for innovation.[365]

Patent prize systems similarly might escape the most blatant rent-seeking abuses. Once an agency is established to award prizes, Congress presumably would be skeptical of requests for prizes outside the system. Greater concerns are the potential for lobbying over the appointment of agency officials and the potential for seeking to influence statutory formulae in ways beneficial to individual companies and industries. These concerns suggest a tradeoff. On one hand, more mechanical proposals entail the risk that special interests may succeed in influencing Congress to adopt an inferior formula or algorithm because it is particularly likely to benefit them. We have seen the danger that a poorly motivated government official could apply a formula in a perverse way, but this danger may be secondary to the possibility of the government adopting a bad formula that prevents even a well-motivated bureaucrat from efficiently distributing prizes. On the other hand, more flexible proposals may increase rent-seeking designed to influence those who will make agency decisions. The challenge is to avoid both dangers.

III. PERFECTING PATENT PRIZES

The recent revival of interest in prize systems, even among such prominent scholars, seems unlikely to lead to full-scale implementation. For one, the change may be simply too radical to be politically palatable in the near future. Calandrillo might be correct that the government would be able to levy sufficient taxes to pay the rewards that would be necessary in a prize system,[366] and Shavell and van Ypersele might be correct in stating that "industry should not object" to an opt-in proposal, "as it can only raise firms' profits."[367] Nonetheless, there might be some special interests opposed to such a

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the "R&D Scare Card," PUBLIC CITIZEN, *at* http://www.citizen.org/congress/reform/archives/claritin/articles.cfm?ID=1077 (last visited Nov. 23, 2001) (criticizing Schering-Plough's attempt).

365. Even if Congress does grant such an extension, the courts might strike it down. *See* Robert Patrick Merges & Glenn Harlan Reynolds, *The Proper Scope of the Copyright and Patent Power*, 37 HARV. J. ON LEGIS. 45, 64-65 (2000) (arguing that courts should scrutinize term extensions, especially if the extensions benefit only a small number of inventors, as potentially violative of the Copyright and Patent Clause).

366. Calandrillo, *supra* note 20, at 345.

367. Shavell & van Ypersele, *supra* note 19, at 544.

change, such as patent attorneys,[368] and there certainly is not a powerful interest lobbying for such a change. Likelihood of adoption, of course, does not detract from the proposals' academic merits, but it does suggest that any reform proposal should be incremental.[369]

An administrative program with a great deal of flexibility for agency decisionmakers is particularly attractive for a pilot program. It is likely to be difficult to anticipate precisely how successful any program for patent prizes will be, and one virtue of flexibility is that if the initial plan proves suboptimal, agency officials will have an opportunity to adjust. Moreover, a relatively flexible program can be quite simple and conventional: Establish an agency and give it money to distribute to pharmaceutical companies that place their patents in the public domain or take some other action to reduce the deadweight cost of patents. It is far easier as a statutory drafting matter to give decisionmakers freedom to estimate the value of a project than it is to tell them how to go about the estimation. Implementation of other design features—such as a rule specifying that the fund should be distributed in proportion to the final assessments—is relatively trivial. While statutory drafting is likely not a significant expense even for far more complicated programs, the familiarity of the structure of such an administrative program, if not its purpose, is a virtue, especially initially.

This is, of course, a simplification of the design decisions that would need to be made in the actual construction of such an administrative agency. One would, for example, face the usual questions about whether the agency should be independent or executive,[370] and whether it should use formal or informal adjudicative processes in determining the value of any particular research

368. Members of the patent bar have in the past expressed opposition to many patent reform proposals. *See, e.g.*, Allan M. Soobert, *Breaking New Grounds in Administrative Revocation of U.S. Patents: A Proposition for Opposition—and Beyond*, 14 SANTA CLARA COMPUTER & HIGH TECH. L.J. 63, 83 (1998) (describing one such instance). The patent bar, of course, is not a monolith, and different groups of attorneys may have different interests. *Cf.* Lee Rousso, Comment, *Japan's New Patent Attorney Law Breaches Barrier Between the "Legal" and "Quasi-Legal" Professions: Integrity of Japanese Patent Practice at Risk?*, 10 PAC. RIM L. & POL'Y J. 781 (2001) (discussing such a conflict in Japan).

369. Shavell and van Ypersele implicitly acknowledge this, concluding in the last line of their article that "serious study of the possibility of reward systems, with a view toward their implementation at least on an experimental, partial basis, is worth contemplating." Shavell & van Ypersele, *supra* note 19, at 545. They do not, however, describe how such an experimental, partial program would work.

370. *See generally* GARY LAWSON, FEDERAL ADMINISTRATIVE LAW 7 (2d ed. 2001) (discussing the differences between independent and executive agencies).

project.[371] The task of calculating patent prizes would seem to argue for an agency that is as independent as possible, to ensure that the best way to obtain a claim on a prize is through actual scientific research, rather than through lobbying. At the same time, if what is important is only that the administrative agency make accurate decisions on average, relatively informal and low-cost adjudicative processes should probably be used. Finally, as Kieff has pointed out, there must be some mechanism to encourage production of information that would reduce the credibility of applicants' claims.[372] A full evaluation of policy options on all these fronts is beyond my scope here, as is full development of an argument that a patent prize agency would be able to keep administrative costs, including rent-seeking costs, to a minimum. Nonetheless, creation of an administrative agency with considerable flexibility to award prizes to those who have placed patents in the public domain would involve far fewer decisions than creation of an agency constrained to follow a particular algorithm or formula, because the statute in the latter case would need to explain exactly how the agency should make particular decisions.

Administrative familiarity and simplicity, of course, are not sufficient to justify any particular approach, and while I have identified in Parts I and II some of the problems associated with formulaic or algorithmic approaches to calculating patent prizes, I have not yet systematically defended flexibility in agency decisionmaking. I will mount such a case in Part III.A, arguing that an agency given total flexibility would function effectively, at least if decisions to take actions are irrevocable and the agency has a fixed amount of money that it must spend.[373] The argument for flexibility, however, may be worthwhile even if Congress were to decide not to give an agency complete discretion, and indeed even if Congress were to decide to take an approach similar to one of the proposals critiqued in Part I. In Part III.B, I will thus show how flexibility might improve any of those proposals. I will also offer a variety of modifications to such proposals, some borrowing from insights of the other commentators.

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371. *Cf.* Deborah R. Hensler, *Does ADR Really Save Money? The Jury's Still Out*, NAT'L L.J., Apr. 11, 1994, at C2 (discussing whether the use of alternative dispute resolution is cost-efficient).

372. *See supra* Part II.A.2.

373. *See supra* text following note 28.

A. The Case for Flexibility

The argument for flexibility is that it has small costs and large benefits. Prizes would not be much more uncertain than patents from the perspective of someone deciding whether to begin a long-term research-and-development project, and any marginal increase in uncertainty is of little concern to well-diversified shareholders. At the same time, flexibility eliminates the possibility of loopholes, so potential prize applicants' only incentive will be to provide social value if this is what eventual prize decisionmakers will seek to measure.

1. The Small Costs of Uncertainty

It is natural to seek certainty in legal affairs,[374] and it may seem even more natural in the design of a prize system.[375] With one prominent recent exception,[376] scholars generally have claimed that the patent system aspires to certainty,[377] with uncertainty decreasing

374. Concern with certainty dates back at least to Blackstone's treatment of the law of custom. Blackstone explained that for a custom to be enforceable despite contrary common law, the custom (among other requirements) had to be certain. *See* 1 WILLIAM BLACKSTONE, COMMENTARIES *78; *see also* David J. Bederman, *The Curious Resurrection of Custom: Beach Access and Judicial Takings*, 96 COLUM. L. REV. 1375, 1389 (1996) (noting that Blackstone's focus on certainty was influenced by earlier commentators).

375. Achieving certainty was indeed a primary aim of Polanyi's early patent prize proposal. Polanyi criticized patent law, stating, "Hard cases occur of course under the operation of every law; but the patent law seems to form a veritable labyrinth of hazards for the interests governed by it." Polanyi, *supra* note 13, at 70. Polanyi continues that patent law "is essentially deficient." He explains:

> [I]t aims at a purpose which cannot be rationally achieved. It tries to parcel up a stream of creative thought into a series of distinct claims, each of which is to constitute the basis of a separately owned monopoly. But the growth of human knowledge cannot be divided up into such sharply circumscribed phases. Ideas usually develop gradually by shades of emphasis, and even when, from time to time, sparks of discovery flare up and suddenly reveal a new understanding, it usually appears on closer scrutiny that the new idea had been at least partly foreshadowed in previous speculations.

Id. at 70-71. I am skeptical of Polanyi's claim that patent law is inherently more ambiguous than other areas of law. Nonetheless, Polanyi is convincing in showing that a patent system, no less than a prize system, is in some ways an artificial construct without complete correspondence to intuitively appealing principles. This helps rebut the argument that patent law is inherently more natural than a prize system because in the former, inventors simply have a monopoly over their own discoveries. The task of determining patent scope may be as artificial as the task of determining monetary awards for individual discoveries.

376. *See* Ian Ayres & Paul Klemperer, *Limiting Patentees' Market Power Without Reducing Innovation Incentives: The Perverse Benefits of Uncertainty and Non-Injunctive Remedies*, 97 MICH. L. REV. 985, 989-93 (1999) (arguing that the level of innovation can be kept constant if the government compensates for less certainty in patents by offering longer patents).

377. For a recent and articulate defense of the importance of certainty in patent law, see Erik S. Maurer, Note & Comment, *An Economic Justification for a Broad Interpretation of Patentable Subject Matter*, 95 NW. U. L. REV. 1057, 1095 (2001) ("[T]he risk of committing Type I

confidence in inventors' abilities to recoup their investments.[378] The patent system offers a mostly decentralized way of encouraging inventors to pursue whatever projects are most likely to increase social wealth, and skepticism about a benevolent government's ability to match the invisible hand is well placed. If a prize system is to match the patent system, it might seem that the government must provide some form of guarantee. A sufficiently rigid formula or algorithm can serve this purpose, assuring that the inventor will profit from innovation. Without such a guarantee, the government might do a poor job in distributing prizes, rewarding unmeritorious inventions over meritorious ones. Why invest billions of dollars on a project when some bureaucrat capriciously might decide that the invention is not sufficiently beneficial for society?

Given the intuitive appeal of this argument, it is hardly surprising that commentators on prize systems seem to be engaged in a search for the best approach to constraining an agency. The argument, however, overstates both the certainty that the patent system provides[379] and the importance of certainty in a prize system. Some of the uncertainty in the patent system itself is embedded in requirements that inevitably will require some judgment. Though concepts like nonobviousness receive detailed treatment in case law,[380] no matter how much explanation is provided, application ultimately

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error by subjectively narrowing the interpretation of patentable subject matter justifies the current, broad, and objective interpretation adopted by the courts and the PTO."). As Thomas Landry notes, the creation of the Federal Circuit reflects a belief that certainty and predictability in patent law are even more important than in other areas. *See* Thomas K. Landry, *Certainty and Discretion in Patent Law: The On Sale Bar, The Doctrine of Equivalents, and Judicial Power in the Federal Circuit*, 67 S. CAL. L. REV. 1151, 1152-53 (1994); *see also* Harry F. Manbeck, Jr., *The Federal Circuit—First Ten Years of Patentability Decisions*, 14 GEO. MASON L. REV. 499, 503 (1992) (arguing that "[t]he added certainty provided by the Federal Circuit is beneficial to both patent applicants and the PTO itself, since it allows for reliable decisions by all concerned in the patent application process").

378. Interestingly, the goal of certainty is often equated with the economic goals of the patent system. For example, David Cohen notes that "economic concerns were of little importance in the formation of German patent law," explaining that in Germany "legal certainty is only one factor to be balanced against the needs of justice for the inventor." David L. Cohen, Comment, *Article 69 and European Patent Integration*, 92 NW. U. L. REV. 1082, 1126 (1998).

379. For articles arguing that the patent system is not as certain as might appear, see Landry, *supra* note 377, at 1159-1203, which provides case studies of patent doctrines, and Craig Allen Nard, *Certainty, Fence Building, and the Useful Arts*, 74 IND. L.J. 759, 763-64 (1999), which argues for greater deference to the PTO as a way of creating greater certainty.

380. *See, e.g.*, Para-Ordnance Mfg., Inc. v. SGS Importers Int'l, Inc., 73 F.3d 1085, 1093-94 (Fed. Cir. 1995) (Archer, C.J., dissenting) (detailing secondary considerations to be considered in considering whether an invention was obvious).

requires some human decision.[381] As in law generally, the existence of litigation suggests that litigants sometimes have different predictions about the law, whether about patent validity or about patent scope.[382] There can be more or less uncertainty and more or less litigation, but the high reversal rate in patent cases suggests that there are at least some difficult cases.[383]

More importantly, even in the absence of any doubt as to the validity and scope of a patent, inventors face considerable uncertainty about the commercial success of the innovation. A product may face unexpected competition, regulatory hurdles, or consumer indifference. These uncertainties may dampen innovation somewhat, but probably not too much. The magic of capital markets allows companies to make speculative bets. Because the public holds a diverse array of securities, the risk of the failure of any one product produced by one company is insignificant, for that failure will be balanced by other successes.[384] A product that has a fifty percent chance of producing a billion-dollar profit and a fifty percent chance of being worthless will not quite be worth five hundred million dollars, because the impossibility of creating a perfectly diversified portfolio makes even companies and shareholders somewhat risk averse.[385] For holders of a relatively diversified portfolio, however, the costs of risk are quite small. And so, companies invest in research and development despite uncertainty about ultimate commercialization prospects, not to mention uncertainty about the results of research and development.

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381. The Federal Circuit itself has recognized the futility of creating a wholly objective test, holding that objective evidence of nonobviousness is not necessarily required for patentability. *See* Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc., 807 F.2d 955, 960 (Fed. Cir. 1986).

382. Economic analyses of settlement predict that cases will settle unless parties are mutually optimistic about outcomes. *See, e.g.*, Lisa Bernstein, *Understanding the Limits of Court-Connected ADR: A Critique of Federal Court-Annexed Arbitration Programs*, 141 U. PA. L. REV. 2169, 2224-26 (1993); George Loewenstein et al., *Self-Serving Assessments of Fairness and Pretrial Bargaining*, 22 J. LEGAL STUD. 135, 135 (1993). *See generally* John P. Gould, *The Economics of Legal Conflicts*, 2 J. LEGAL STUD. 279, 281-86 (1973) (providing an economic model of litigation and settlement).

383. For a comprehensive study demonstrating that district courts err in a large number of patent cases, see Kimberly A. Moore, *Are District Judges Equipped to Resolve Patent Cases?*, 15 HARV. J.L. & TECH. 1 (2001).

384. *See, e.g.*, Paul G. Haskell, *The Prudent Person Rule for Trustee Investment and Modern Portfolio Theory*, 69 N.C. L. REV. 87, 108 (1990) ("[U]nder portfolio theory the well-diversified portfolio may have a low level of risk despite the presence of individually volatile components."). *See generally* Harry M. Markowitz, *Portfolio Selection*, 7 J. FIN. 77 (1952) (providing a seminal approach to portfolio theory).

385. Companies may be more risk averse than their shareholders because of agency problems. *See, e.g.*, SCHERER & ROSS, *supra* note 43, at 46 (discussing the phenomenon of "empire building" by managers).

Even gross uncertainty in a prize system is thus unlikely to have a substantial effect on innovation. Lichtman recognizes, "It does not matter if one innovator is overcompensated and another is undercompensated, as long as the average payment is approximately correct."[386] The possibility that what would have been a company's billion-dollar drug may end up producing zero or two billion will have little effect on the company's incentive to produce the drug. A decision by the prize agency might come more quickly and suddenly than a decision in the marketplace, thus producing potentially significant stock volatility,[387] but the prospect that a drug might turn out to be a failure sooner rather than later is not troublesome. Reduced uncertainty may have some benefits; we would not, after all, be indifferent to companies' gambling millions on roulette, even with fair odds. These benefits, though, are modest—an insufficient basis to make a strong policy case for constraint over discretion. If there is thus some compensating benefit to a prize system—for example, if prizes are awarded based on the social value of a patent rather than on the lower private value—some will choose the patent system. In any event, there is no basis for concern that all patent holders would spurn an optional prize system. If the government promises to distribute a certain amount of money to companies making sacrifices, the individual incentives of each company will result in the total sacrifices adding up to almost the amount being distributed, with the differential representing the cost of risk. This outcome at least will be the result in equilibrium, since if relatively few patent holders participate, others will have a large incentive to join.

The greater concern with giving an agency wide flexibility in distributing prizes is that the government might make errors. For example, the agency might ignore market data about the importance of patents yielded into the public domain, instead seeking to reward companies that have helped the agency pursue its own agenda. Perhaps the government would seek to reward the developer of a technology that promises to reduce air pollution in automobiles even if that technology has deficiencies that make it unattractive commercially.[388] An agency might be inclined to give large awards to a

386. Lichtman, *supra* note 22, at 132. Lichtman also adds that "[e]rror in and of itself raises distributional, but not efficiency, concerns." *Id.*

387. On the significance and sources of stock market volatility, see Clifford W. Smith, Jr., *Market Volatility: Causes and Consequences*, 74 CORNELL L. REV. 953 (1989).

388. I use this as an example because of criticisms that federal attempts to reduce pollution have focused excessively on command-and-control approaches despite their lack of success in efficiently reducing pollution. *See, e.g.*, Eric W. Orts, *Reflexive Environmental Law*, 89 NW. U. L. REV. 1227, 1235-41 (1995).

company producing an innovation that has received favorable attention in the popular press, even if the innovation suffers from obvious deficiencies. Government has a poor record picking "winners" in industrial policy,[389] and if there is reason to suspect that an agency systematically will pursue an agenda instead of rewarding innovation, that suspicion will distort investment.

The answer to this objection, and the most critical point of this Article, is that errors in prize decisions usually do not matter. The decisions that matter from a social perspective are the investors' decisions whether to invest and whether to opt for a prize instead of full exploitation of a patent. Governmental errors in awarding prizes will affect these decisions only if the errors are predictable in advance. This conclusion is counterintuitive, because in most contexts the prospect that the government might make bad decisions counts as a mark against these programs. Usually the government spends money to accomplish something in the future, but when the government ultimately distributes money in a prize system, it rewards activity in the past. Thus, while flawed governmental decisionmaking in awarding prizes might increase risk slightly, it is otherwise of concern only if the government's biases are predictable in advance. And if such biases are predictable, a simple solution is to add a substantial delay before the government makes its decision, with any government funds committed to the project invested in the interim and thus allowed to earn an ordinary rate of return. Such delay would ease the government's decisionmaking task by allowing it to evaluate the actual success of a product and would make it more difficult to predict who the decisionmaker in a particular case would be and thus whether that decisionmaker would have any known biases.

2. The Large Benefits of Flexibility

The possibility that inventors would be able to predict some bias in a prize system is less worrisome than the certainty that a constrained system would have built-in biases. We have seen that each of the various patent proposals ignores data that ought to be relevant to decisions about prizes. The Guell and Fischbaum proposal ignores sales data after the initial market test,[390] while the Shavell–van Ypersele approach assumes that a patent will have no value as a foundation for subsequent innovations.[391] The Kremer mechanism will lead to overcompensation for complementary patents not identified by

389. *See* Hart, *supra* note 48, at 36.

390. *See supra* text accompanying notes 62-65.

391. *See supra* text accompanying note 98.

the government agency,[392] while the Lichtman approach risks providing coupons without substantially limiting deadweight loss.[393] In addition, none of the proposals would lead the government agency to consider any social loss that release of a patent might cause through rent dissipation in development of follow-on innovations.[394] A flexible system, in contrast, will not be subject to structure-induced biases and can take into account a large number of considerations, including rent dissipation.

Moreover, because each of the proposals necessarily would entail subjective decisionmaking, there is no guarantee that even a constrained system will prevent agency bias. An agency might, for example, estimate demand curves in such a way as to advance the projects that it prefers,[395] or award large coupons as a means of rewarding a company without consideration of whether the coupons are provided to the correct individuals to lower deadweight loss. Thus, constrained proposals inevitably prevent the government from making appropriate adjustments, while failing to ensure that bias will not contaminate administrative outcomes. Of course, an agency might use its discretion in a constrained system to take into account some legitimate factors not explicitly addressed in a constrained system, such as rent dissipation. To the extent that this makes a constrained system more like an unconstrained one, such discretion may make the proposals closer. Nonetheless, incorporation of legitimate factors in a prize system not designed to accommodate them would be messy at best, while general bias for or against an applicant would be easy to achieve simply by estimating individual variables in a biased way.

Perhaps the greatest advantage of a flexible system over a constrained one is that it would allow different approaches to reducing deadweight loss to be used in different circumstances. We have seen that a variety of factors affect which approach to reducing deadweight loss is best. Where government information is sufficiently good, a coupon scheme might be preferable to a patent buyout.[396] Where a product market is unlikely to be competitive regardless of whether a patent is released into the public domain, the best solution may be a reduction in price by the patent holder.[397] Even if a patent buyout is optimal, different methods of valuing the patent may be appropriate. When there is a one-to-one relationship between a patent and a

392. *See supra* text accompanying notes 151-52.

393. *See supra* text accompanying notes 174-75.

394. *See supra* Part II.B.

395. *See supra* text accompanying notes 110-11.

396. *See supra* text accompanying note 177.

397. *See supra* notes 178-81 and accompanying text.

product, the Shavell–van Ypersele formula may prove useful.[398] On the other hand, when a substantial portion of the value of a patent relates to its contribution of a foundation for follow-up innovations, the Kremer market scheme may be more accurate, especially if the patent is not complementary with others.[399] Similarly, we have seen that sometimes it may be optimal to obtain a patent and then release it to the public domain, while at other times it may be preferable to provide prizes for companies skipping the patent process altogether.[400] In theory, it might be possible to create a complex formula to determine the optimal approach for each patent, but the number of considerations is so staggering that it seems unlikely that an effective formula could be developed in advance.

A system in which agency officials are unconstrained helps accomplish this objective by allowing patent holders to choose whatever means of reducing the effects of monopoly that they wish and subsequently permitting agency officials to tailor awards based on the benefit of the scheme chosen.[401] For example, if a company decided to reduce the monopoly effects of its patent by giving coupons, the agency nonetheless might conclude that no decrease in deadweight loss resulted if the coupons simply allowed the monopolist to charge more than it otherwise would have. As long as potential prize applicants anticipate that the agency will base prizes on reduction in deadweight loss accurately on average, applicants will have an incentive to select the method that will achieve the greatest benefit at lowest cost. The same logic goes for any other factor that the agency ought to take into account. The agency, for example, might reduce prizes when release of a patent into the public domain leads to inefficient rent dissipation. Although it might be difficult to calculate the extent of this inefficiency,[402] as long as the agency's adjustments

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398. *See supra* notes 101-04 and accompanying text.

399. Bidders would have incentives to calculate the value of the patent, regardless of the extent to which this value stems from direct sales of a product or licensing or exploitation of the patent for follow-up inventions. *See supra* note 115 and accompanying text.

400. *See supra* text accompanying note 347.

401. Such a system also might discourage patent holders from taking any actions to reduce deadweight costs if those actions would increase other costs. For example, one commentator has developed a model suggesting that broad patent protection for antibiotics may be beneficial, because excessive use of antibiotics may lead to resistance, thus making them less valuable in the future. *See generally* Ramanan Laxminarayan & Gardner M. Brown, *Eeonomics of Antibiotics Resistance: A Theory of Optimal Use*, J. ENVTL. ECON. & MGMT. (forthcoming), *available at* http://www.rff.org/CFDOCS/disc_papers/PDF_files/0036.pdf (last visited Dec. 16, 2002).

402. Such calculations would not be impossible. *Cf.* Grady & Alexander, *supra* note 198, at 313 (suggesting that criticisms that the patent system simply could not take into account variables, like the difficulty of developing an invention, are overstated). One might consider

are correct on average, patent holders will have optimal incentives in choosing an approach, if any, to eliminating or reducing deadweight loss.

Similarly, patent holders choosing to release their patents into the public domain would have incentives to accede to procedures for valuing the patents when doing so would be efficient. A holder of a patent that would be relatively difficult to value by examining sales could accede to Kremer's scheme. Even without government involvement, a private group might perform a similar function, auctioning patents using the same randomization procedure that Kremer recommended. Presumably, there would be some cost involved, but a patent holder might do so as a way of certifying results to the government agency. Similarly, a patent holder might hire an independent accounting firm to estimate the value of a patent being placed in the public domain. These methods might increase the confidence that an agency will have in its ultimate prize assessment and thus reduce the amount by which the agency would decrease prizes as a way of accounting for the adverse selection problem.[403] Of course, using these procedures entails costs, but these costs may be worth undertaking in some cases if not in others.[404]

That a system in which agency officials are given flexibility is superior to one adopting a single approach does not necessarily mean that tbe agency should be given no guidance whatsoever. The statute creating the agency usefully might catalogue some of the considerations that should be taken into account in calculating prizes. By explicitly indicating that an agency should take into account a particular factor, Congress could avoid the danger that companies might believe that the agency will ignore a factor even though that factor seems important to economic efficiency. That danger also could be lessened by requiring the agency to document its calculations and to explain why it rejected any arguments for considering a factor suggested by the applicant or an adversary. The virtue of requiring such explanations is similar to that of requiring appellate judges to

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different companies' investments in follow-up inventions and the profits from those inventions. If the profits tend to amount only to a fair rate of return on capital, rent dissipation has prohably occurred. Such a conclusion would be bolstered by evidence of redundant research by competing companies.

403. *See* Shavell & van Ypersele, *supra* note 19, at 539-40 (optimizing the amount by which prizes should be lower than the anticipated social surplus).

404. Sometimes, it might seem, a patent holder would have excessive incentives to provide verification of patent value, because the benefit in terms of a greater prize accrues solely to the patent holder. In theory, though, the agency might punish excessive spending on administrative costs by reducing the prize. Once again, as long as the agency makes the appropriate reduction on average, companies will have appropriate ex ante incentives.

produce written opinions,[405] providing the decisionmaker with a reputational incentive to demonstrate consideration of all relevant factors.

Of course, I may not have anticipated all potentially relevant factors, and Congress might do no better. Ultimately, though, this is an argument for flexibility, not an argument against it. Indeed, one virtue of allowing flexibility is that it might stimulate further research into when it is efficient to grant prizes and the optimal amount of these prizes. If an agency simply applies a formula, academic commentators might urge reforms and changes, but private parties would have little incentive to do anything other than plug projections into the government-mandated equation. With a flexible agency, prize applicants will be incentivized to advertise any way in which the efforts they make improve social welfare. Similarly, if an adversary system is used to resolve prize claims, the adverse parties would have an incentive to identify any inefficiencies that should offset prize awards. These analyses might be useful beyond individual cases in promoting understanding of the value of prizes.

To some, the notion of simply giving a government agency money to spend, while not unheard of,[406] is utopian and foolish. We know, the argument goes, that the government simply will not do a good job of spending it, and there is a good reason that we do not generally give agencies large amounts of money to distribute based on the whims of individual decisionmakers. Retrospective prizes, though, are different from other government programs, because what matters from a social perspective is not individual prize decisions themselves, but predictions about those decisions. We cannot be satisfied if some

405. "The publication of written opinions provides judges witb an opportunity to criticize colleagues, and allows members of the bar and academia to criticize sitting judges when the authors of puhlished opinions fail to abide by their own stated principles in future cases." Maxwell L. Stearns, *Standing Back from the Forest: Justiciability and Social Choice*, 83 CAL. L. REV. 1309, 1349 (1995). Commentators interested in improving the quality of decisionmaking have called for requiring written opinions in various contexts. *See* Martha J. Dragich, *Will the Federal Courts of Appeals Perish If They Publish? Or Does the Declining Use of Opinions to Explain and Justify Judicial Decisions Pose a Greater Threat?*, 44 AM. U. L. REV. 757, 800-02 (1995) (arguing for written, published opinions in the federal appellate courts); Christopher B. Kaczmarek, *Public Law Deserves Public Justice: Why Public Law Arbitrators Should Be Required to Issue Written, Publishable Opinions*, 4 EMPLOYEE RTS. & EMP. POL'Y J. 285, 312-25 (2000) (arguing that arbitrators should issue written opinions). For articles assessing the importance of written opinions more broadly, see Frederick Schauer, *Opinions as Rules*, 62 U. CHI. L. REV. 1455, 1474-75 (1995); James Boyd White, *What's an Opinion for?*, 62 U. CHI. L. REV. 1363, 1363-69 (1995).

406. Agencies are often given considerahle freedom when they are given lump-sum appropriations. *See* Kate Stith, *Rewriting the Fiscal Constitution: The Case of Gramm-Rudman-Hollings*, 76 CAL. L. REV. 593, 612-13 (1988) (documenting the increasing prevalence of lump-sum appropriations over the twentieth century).

social security recipients receive twice what they should and some deserving receive nothing.[407] But with prizes, if the average governmental decisionmaker will be expected to get it right, that is good enough.[408] If someone contemplating releasing a patent into the public domain anticipates that he might receive twice his estimate of the social benefit half the time and nothing at all half the time, he still might release the patent.

Prize systems may not be unique among legal institutions in being able to achieve an aim well even if decisions are noisy. Tort scholars have observed that the tort system could provide the appropriate amount of deterrence even if individual decisions are variable.[409] For example, economists have argued that if punitive damages imposed on tortfeasors when they are caught compensate for the chance that tortfeasors sometimes will not be caught, deterrence will be optimized.[410] Of course, in tort law, many scholars argue that

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407. Some level of incoherence and inconsistency in the operation of such a program, however, may be inevitable. *See* JERRY L. MASHAW, BUREAUCRATIC JUSTICE: MANAGING SOCIAL SECURITY DISABILITY CLAIMS 49-78 (1983).

408. If looking only at the universe of settled civil cases, achieving justice on average may be good enough too, since settlements reflect expected values of verdicts. This logic suggests that settled cases may acbieve a higher level of justice than litigated cases, in which there is a possibility that the court might err significantly. *See, e.g.*, Josbua P. Davis, *Toward a Jurisprudence of Trial and Settlement: Allocating Attorney's Fees by Amending Federal Rule of Civil Procedure 68*, 48 ALA. L. REV. 65, 122 (1996) ("Settlement for the expected outcome may not yield perfect justice, but neither will it yield perfect injustice.").

409. Louis Kaplow, for example, explains, "Accuracy in the assessment of damages is relevant primarily because of how it affects the precision with which legal rules control behavior." Louis Kaplow, *The Value of Accuracy in Adjudication: An Economic Analysis*, 23 J. LEGAL STUD. 307, 399 (1994). If there is simply a fifty percent chance of receiving zero damages and a one bundred percent chance of receiving double damages, tbe expected damage, at least for a risk-neutral party, is unaffected. Thus, inaccuracy matters only to the extent it affects ex ante expectations and imposes risk costs on risk-averse parties. As Kaplow and Shavell explain:

> [A]ccuracy in the assessment of barm cannot influence the behavior of injurers—and is therefore of no social value—to the degree that they lack knowledge of the level of harm they might cause when they make their decisions. Thus, if, when cboosing his precautions, an injurer knows only that the average level of harm that would be caused in an accident is $500,000, there is no point in the court's measuring harm accurately. As long as the injurer's expected liability is $500,000, his behavior will be the same as if harm were measured precisely.

Louis Kaplow & Steven Shavell, *Accuracy in the Assessment of Damages*, 39 J.L. & ECON. 191, 192 (1996). *But see* Randall R. Bovbjerg et al., *Valuing Life and Limb in Tort: Scheduling "Pain and Suffering,"* 83 NW. U. L. REV. 908, 925 (1989) ("[H]ighly variable, unpredictable valuations undercut the *deterrence* function of tort law. Where liability costs are relatively predictable, they can be avoided (where it is efficient to do so) or 'built in' to the costs of goods and services."). The problem with this analysis is that potential tortfeasors will avoid uncertain liability at least as much as certain liability, if uncertainty can equally result in greater or lower damages than would be efficient.

410. *See, e.g.*, A. Mitchell Polinsky & Steven Shavell, *Punitive Damages: An Economic Analysis*, 111 HARV. L. REV. 869, 887-88 (1998).

economic efficiency should not be the only goal,[411] and that consideration of factors other than optimal deterrence therefore might lead to systematic overdeterrence or underdeterrence. Disagreement over fundamental premises should be less of a danger in patent law.[412] In addition, while jury-based decisionmaking may make tort law difficult to rationalize,[413] prize determinations presumably would be made by government officials rather than juries.

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411. Jules Coleman argues that economic analysis does not even produce the best positive analysis of tort practice. *See, e.g.*, COLEMAN, *supra* note 261, 361-85 (providing a comprehensive guide to his theory of corrective justice); Jules L. Coleman, *The Practice of Corrective Justice*, 37 ARIZ. L. REV. 15, 30-31 (1995) (considering some meta-issues in articulating a theory of corrective justice). Similarly, some scholars argue that even if economic efficiency is the only goal, optimal deterrence may trade off with other efficiency concerns. *See, e.g.*, Michael Abramowicz, *A Compromise Approach to Compromise Verdicts*, 89 CAL. L. REV. 231, 271 (2001) (noting a tension between optimizing deterrence of harm-causing acts and optimizing incentives for firms to enter into industries, membership in which might lead to erroneous findings of liability).

412. The vast majority of patent law scholarship is utilitarian and economic, in spirit, if not in form. For explicitly noneconomic analyses of intellectual property law, see Wendy J. Gordon, *A Property Right in Self-Expression: Equality and Individualism in the Natural Law of Intellectual Property*, 102 YALE L.J. 1533, 1540-83 (1993), which defends a natural rights approach for patent, copyright, and trademark law; and Steven Cherensky, Comment, *A Penny for Their Thoughts: Employee-Inventors, Preinvention Assignment Agreements, Property, and Personhood*, 81 CAL. L. REV. 597, 641-66 (1993), which argues that an employee's personhood should be a primary consideration in law concerning preinvention assignments of property rights. A. Samuel Oddi, meanwhile, has argued that natural rights concepts help explain the acceptance of a universal standard of patent law even by countries that might not benefit from such a standard. *See* Oddi, *supra* note 46, at 417-40. Part of the reason for the dominance of utilitarian arguments is that scholars have generally believed that the Framers defended intellectual property using such arguments, but a recent intellectual history suggests that natural rights arguments were important as well. *See* Adam Mossoff, *Rethinking the Development of Patents: An Intellectual History, 1550-1800*, 52 HASTINGS L.J. 1255, 1313-15 (2001).

Even someone accepting a natural rights, rather than an economic approach, to patent law would not necessarily object to a prize system on the ground that such a system would deprive inventors of their natural rights. Professor Gordon's natural rights analysis, for example, emphasizes that the claims of a creator of intellectual property do not necessarily trump those of the public to use intellectual property. *See* Gordon, *supra*, at 1544-72. Specifically, she argues "that creators should have property in their original works, only provided that such grant of property does no harm to other persons' equal abilities to create or to draw upon the preexisting cultural matrix and scientific heritage." *Id.* at 1563-64. Professor Gordon argues that this requirement might be satisfied by an intellectual property regime in which the right was protected only by a liability rule. *Id.* at 1572-76. If such a regime would not infringe on the natural rights of a creator of intellectual property, then a like regime in which "damages" are paid by society as a whole rather than by individual users of the property would not infringe on the creator's rights—at least if we assume the legitimacy of the taxation needed to pay the prizes. Indeed, under a natural rights approach, a prize system may be more appealing than the existing patent system, because such a system would reduce interference with the public's access to the common by increasing the number of works placed in the public domain.

413. One reason for this is that even where juries agree on moral desert, they exhibit high variability in translating such judgments into dollar figures. *See* Cass R. Sunstein et al., *Assessing Punitive Damages (With Notes on Cognition and Valuation in Law)*, 107 YALE L.J. 2071, 2142-45 (1998).

B. Perfected Proposals

The argument for flexibility suggests that, with appropriate administrative design decisions to achieve agency independence and reduce wasteful rent seeking, a virtually unrestricted agency might do an effective job at distributing patent prizes. The case for flexibility, however, also could be made in conjunction with other proposals, and each of these proposals could benefit from insights that the other proposals offer. In this section, I offer variants on the different proposals assessed in Part I. I first explain in Part III.B.1 how a judicial proceeding or a test market might be a more viable strategy than it first appeared, especially with certain changes, such as one designed to take advantage of the patent holder's information about the relative attractiveness of different markets. Then, in Part III.B.2, I explain that the formula devised by Shavell and van Ypersele might serve as a starting point for determining a prize, with appropriate downward or upward adjustments for other relevant considerations. Then, in Part III.B.3, I make a similar point about Kremer's proposal, and then describe an auction mechanism that is distinct from Kremer's but would allow the government to obtain the benefit of private information and use that as a starting point for calculating a reward. Finally, in Part III.B.4, I explain how Lichtman's proposal for a coupon scheme would be more attractive if the government ex post seeks to determine whether the patent holder reduced prices by a sufficient amount and whether the coupons were distributed effectively.

1. Self-Assessment Test Market

The Guell and Fischbaum proposal was in fact two separate proposals combined into one: the use of judicial condemnation proceedings to determine compensation and the use of a market appeal. The argument for flexibility interestingly makes each of these proposals individually more attractive than it otherwise would be, at least with modest revisions, though probably not in combination. Let us first consider judicial condemnation proceedings. The most apparent disadvantage of judicial proceedings is concern about judicial competence.[414] My argument suggests that this concern is not so great; even if judges, steeped in law rather than economics, made many mistakes in valuing patents, they might make decisions approximately correct on average, and thus such proceedings would

414. Indeed, Guell and Fischbaum explicitly acknowledge this concern. Guell & Fischbaum, *supra* note 29, at 225.

not distort innovation incentives. Moreover, there is a significant virtue to using the judiciary to make such decisions. Judges, especially federal judges, are independent,[415] and so parties seeking prizes would be unlikely to engage in rent-seeking campaigns to influence the decisionmakers. At the same time, patent holders would not be able to predict in advance the identity of judicial decisionmakers given random selection of judges, and they thus would not make decisions based on the idiosyncratic preferences of particular individuals.

Nonetheless, despite judicial oversight, condemnation proceedings are routinely criticized for providing too little compensation to property owners,[416] and they thus raise the danger of inadequate compensation, dampening innovation incentives. Merely providing a limited agency budget would not solve this compensation problem, as the agency would be able to condemn more patents for the dollars given than might be socially optimal if they expect favorable judicial decisions. Nonetheless, judicial proceedings conceivably could be used to value patents voluntarily placed into the public domain by patent holders. A statute could even provide that a set amount of money, such as $1 billion, should be distributed in proportion to the judicial valuations of voluntarily released patents. With these modifications, the Guell and Fischbaum proposal, minus the right to a test market appeal, is essentially my principal proposal, with the alteration that the ultimate decisionmakers would be judges rather than agency bureaucrats.

The test market proposal in isolation, however, also becomes more attractive given my argument in favor of flexibility. Recall that my primary criticism of the test market was that it might be difficult to extrapolate from the firm's profits in the test market across both space and time to determine what the value of a patent placed in the public domain would have been if it had instead been exploited

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415. Judicial independence is not assured in all governmental systems. *See, e.g.*, Laifan Lin, *Judicial Independence in Japan: A Re-Investigation for China*, 13 COLUM. J. ASIAN L. 185, 197-201 (1999). Whatever the virtues of judicial independence in other contexts, there is a strong case for a country implementing a patent prize system to assure the independence of its decisionmakers.

416. *See* William A. Fischel, *The Offer/Ask Disparity and Just Compensation for Takings: A Constitutional Choice Perspective*, 15 INT'L REV. L. & ECON. 187, 193 (1995) (noting that the Framers recognized that in practice "just compensation" might be low). One complaint is that courts often seek to determine market value, without considering that value to owners may be higher. *See, e.g.*, RICHARD A. EPSTEIN, TAKINGS: PRIVATE PROPERTY AND THE POWER OF EMINENT DOMAIN 53 (1985); James G. Durham, *Efficient Just Compensation as a Limit on Eminent Domain*, 69 MINN. L. REV. 1277, 1278-79 (1985); Note, *Condemnations, Implicit Benefits, and Collective Losses: Achieving Just Compensation Through "Community,"* 107 HARV. L. REV. 696, 696 (1994).

monopolistically.[417] The argument for flexibility, however, suggests that this concern is not all that significant, at least if the government does not try to respond to this perceived problem by crafting detailed but inevitably imperfect rules detailing how the agency should accomplish this extrapolation. If the agency does the best job in extrapolating that it can, then as long as it does not make predictable, systematic errors, any inaccuracies will be relatively harmless. Meanwhile, the test market approach could be combined with the approach of granting the agency a fixed amount of money and adjusting the agency's estimations up or down to equal that amount of money, in order to prevent systematic errors from distorting decisionmaking.

Perhaps the greatest danger in this revised version of the test market approach is an adverse selection problem[418]—that the companies most likely to opt in would be those who find that the techniques that the agency uses for conducting the extrapolation most overstate the actual value of the patent. This problem might be addressed by seeking, as Kremer's proposal does, to take advantage of private information, although here the government might rely straightforwardly on the patent holder's own private information rather than that of third parties. A simple approach would be to require the patent holder to indicate for each state or region how much the patent holder expects to earn in that state or region, with the percentages adding up to one hundred percent. Then, the agency could select a particular region from that list, perhaps at random, and calculate the total expected profits for all regions on the basis of that percentage. So, if the test market were conducted in California, and the company had specified that it expected twenty percent of profits from that region, then the agency would calculate national sales by multiplying by five. A risk-averse company would have an incentive honestly to state how large its profits would be in each region.

A similar approach could be used to extrapolate across time. If the company, for example, concludes that it would expect an equal amount of profit in each year of the patent, the agency would then choose *when* the patent would enter into the public domain. Thus, if a company falsely claimed that the first years would represent only a very small percentage of sales, the agency might choose to have the patent enter into the public domain relatively late, and the company would be undercompensated for the remaining years of the patent. This solution, however, is not ideal, as it compounds the problem of

417. *See supra* text accompanying notes 62-65.

418. *See supra* Part II.C.

delaying the entry of the patent into the public domain. An alternative approach would be to require the company to estimate what percentage of sales would occur in each year that the patent was in the public domain, with the agency relying on these estimates to make appropriate extrapolations. After the period that would have been the patent period expired, the agency would determine whether its prediction had been correct. The company, which would be required to bond itself, would then be required to return an appropriate percentage of the prize if it had inaccurately forecast high future success.[419] The exact amount required to be returned, with appropriate adjustments based on interest rates, might be difficult to calculate, but the general case for flexibility suggests that unpredictable errors in such calculations would not hurt investment incentives.

2. A Revised Prize Formula

The argument for flexibility weakens Shavell and van Ypersele's defense of the formula that they derive. Because that formula does not take into account numerous relevant criteria, agency decisions may be inaccurate in predictable ways, and those inaccuracies will distort decisions on investment and on whether to opt into the prize system. A relatively simple fix would be to allow the agency to use the prize formula as a starting point, with the agency making discretionary adjustments for other relevant considerations. For example, the agency might reduce a prize if release of a patent into the public domain would be expected to result in rent-dissipating races for improvements on the patent. Similarly, the government could calculate the function using the product that is most significantly connected with the patent. It could then make upward adjustments if the patent is used in other products as well, and it could make downward adjustments to the extent that a particular product's development was based on contributions other than the patent. Indeed, Shavell and van Ypersele's observation that prizes could be adjusted upward or downward based on sales itself provides some support for this approach,[420] although their claim is presumably that updated sales figures could simply be plugged into the relevant formula. A more flexible approach is likely to be superior to mechanical use of sales figures. After all, it is impossible to determine from sales alone whether a million people bought a pill priced at

419. One virtue of this approach is that it would give the company a continued incentive to market the product. *See supra* Part II.A.1.

420. *See supra* note 95 and accompanying text.

almost nothing because they thought it would save their lives or because they thought that there was an outside shot that it might provide a marginal nutritional benefit, a relevant piece of information in determining what a patent would have been worth had it not been placed in the public domain.

Even if the basic Shavell–van Ypersele approach of considering possible demand curves is a useful foundation, however, the ultimate formula that they derive for an optional prize system is likely unnecessary and suboptimal. Recall that the formula that Shavell and van Ypersele used produced relatively low prizes to accommodate the adverse selection problem, with the authors reasoning that when the calculation was too low, the inventor simply would decide not to opt in.[421] The approach that I have recommended, in contrast, would require inventors to make irrevocable decisions to opt into the prize system in exchange for a prize, thus greatly mitigating the adverse selection concern. Although a patent holder might suspect that the government would overestimate the value of its patent, it could not simply wait for the government to make its valuation decision to be sure. The more flexible the agency is in deviating from the formula, the less a patent holder will be able to guess accurately when the government is likely to overestimate a patent's value. While flexibility does not answer my critique that governmental officials might not be well motivated,[422] the agency could distribute a fund in proportion to its valuations, which I have explained eliminates concerns about systematically biased valuations. With these modifications, the Shavell and van Ypersele approach is once again close to the proposal that I have made, with the analysis of demand curves an essential but not dispositive element in decisions about the size of prize grants.

3. Alternative Auctions

At times, Kremer's article seems to concede that his auction proposal will work most effectively only if the government has flexibility. To combat problems such as collusion, Kremer imagines an agency seeking out suspicious activity and developing ceiling prices that would cap the maximum amount that the government could pay for a patent.[423] There is an irony, however, to such concessions; Kremer's price cap would depend on "an administrative estimate of the social value of the drug per dose or per patient,"[424] an estimate

421. *See supra* notes 86-87 and accompanying text.

422. *See supra* notes 108-09 and accompanying text.

423. *See supra* notes 130-33 and accompanying text.

424. Kremer, *supra* note 21, at 1160.

that, if reliable, would obviate the need for his auction proposal. At other times, Kremer seems resistant to flexibility. He suggests that the government use a markup to pay patent holders more than the private value of their inventions,[425] but he does not consider the possibility that a different markup would be appropriate in different cases, depending on the proportion of social value that a particular patent holder could capture through private exploitation of the patent. He advocates that the amount the government pays should be a "multiple of the third highest bid,"[426] even though there is no reason to believe that the third highest bid is the best one to use in all cases, regardless of the competitiveness of the auction. In seeking to develop an algorithm for calculating patent prizes, Kremer adopts a one-size-fits-all approach.

As with the other proposals that I have discussed, flexibility could help. An auction mechanism of the type that Kremer advocates could be used to provide a baseline for approximating the value of a patent. Rather than have the government simply make an offer to the patent holder to execute the randomization function, an aspect of Kremer's proposal that exacerbates the adverse selection problem, a patent holder could be required to opt irrevocably for the prize mechanism. After the auction, a government agency could then consider specific aspects of the patent and auction to determine a value in a particular case. The more competitive the auction, greater is the case against overriding the price produced by the auction mechanism. Any evidence of collusion would cause the agency to place less weight on the result of the auction itself, and even in the absence of explicit evidence of collusion, the government might disregard the auction total if the bids seemed implausibly high. Other considerations, such as the possibility of loss from excessive improvements on the invention, also could affect the total amount paid. Because the auctions would serve as an anchor for the agency's decisionmaking, this approach would allow the government to harness third-party information without putting the government in the straightjacket of a flawed and exploitable auction mechanism.

Of course, flexibility might increase the uncertainty that auction participants would face, but less so than a proposal not based on auctions at all. Moreover, because the government would focus primarily on whether to deviate from the auction result, there may be less danger of governmental errors, and even if the government does make errors, once again only systematic errors are of any

425. *Id.* at 1142.

426. *Id.* at 1148.

consequence. Systematic errors, of course, might still be a concern. While the existence of any markup, even one calculated on a case-by-case basis, makes it unlikely that prize decisionmakers systematically would shortchange applicants, there might be a danger of systematically inflated valuations. A relatively simple solution to this problem would be to require that the government's total deviations from values suggested by a simple formula add up to zero, so that if the government decided to deviate from the result of the auction with a standard markup for one applicant, it would need to deviate downward for another. Of course, the adjusted auction proposal also is compatible with the approach of distributing a set amount of money in proportion to the government's calculation of social value. With this approach, the ultimate amount received by an applicant would depend on the result of the auction, the agency's discretionary adjustment from the auction-determined price, and then an automatic adjustment so that each applicant receives a proportional share of the fund.

The recognition that flexibility imposes few costs might allow for other improvements in the auction mechanism as well. The reason that collusion might lead bidders to overbid is that they will have to pay for their overbidding only one-tenth of the time, but if bidders were required to pay ten times the excess amount this one-tenth the time, there would be no room for collusion. One way to accomplish this task would be for the government, in the one-tenth of cases that are randomized to a private party, to estimate the company's profits from ownership of the patent after a number of years had elapsed since the initial randomization. If the profits turned out to be positive, the government would provide the company with nine times these profits; if they turned out to be negative, the company would be required to pay the government nine times its loss. A full assessment of this proposal is beyond the scope of this Article; relevant considerations would include risk aversion and the increased amount of risk placed on bidders. But the immediate point is that the difficulty of calculating actual profits in advance ought not to be an obstacle. Measuring actual profits should in any event be easier than calculating what profits would have been if a patent were not placed in the public domain, but the argument for flexibility shows that errors, as long as they are not predictable and systematic, matter little.

In the end, the costs of this adjustment mechanism might well exceed its benefits, and more broadly the costs of an auction might not be worth any corresponding decrease in uncertainty relative to an agency that estimates social benefit without an auction. Kremer's particular auction proposal in any event is not uniquely capable of allowing the government to benefit from third-party information about

the value of patents. An alternative that might be useful here could be adopted from a proposal offered by Ian Ayres and Paul Klemperer.[427] Ayres and Klemperer describe what they call a "duopoly auction," in which a patent holder auctions a license to use the patented invention. In their article, the duopoly auction serves as one possible way that the government could effect a welfare-increasing tradeoff in which a patent holder receives a longer patent term and a weaker patent.[428] The duopoly price would be lower than the monopoly price, thus reducing the deadweight loss associated with patent protection.

The Ayres-Klemperer proposal depends on the welfare benefits associated with the decreased price during the original patent term exceeding the welfare costs of the increased price after the original patent term expires.[429] Whether or not this tradeoff is a sensible one, the proposal is easy to transform into a prize system, by having the government pay the patent holder with cash instead of with a longer patent term. That is, the patent holder would receive not only the revenues from the duopoly auction, but also an additional amount from the government. That amount could be based on the auction revenues themselves, because greater auction revenues indicate a more valuable patent, and thus presumably a greater increase in deadweight loss attributable to competition.[430] Of course, the proposal for a duopoly auction could be replaced with one for an oligopoly auction, with two or more competitors receiving licenses. The more licenses that are auctioned, the greater the reduction in both the deadweight loss and the incentive to innovate, but up to a point the

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427. Ayres & Klemperer, *supra* note 183, at 1031-32.

428. Ayres and Klemperer explain:

> Limited amounts of infringement combined with increased patent duration, however, can substantially reduce the distortionary ex post effects of supra-competitive pricing without reducing the patentee's ex ante incentives to innovate. Indeed, this Article derives a legal regime that preserves the incentive to innovate by giving the patentee the same expected profits, but that suhstantially increases efficiency in comparison with an "idealized" patent regime . . . .

Id. at 986-87.

429. Gideon Parchomovsky and Peter Siegelman argue in favor of a different proposal, allowing patent holders to exploit their market position through trademarks, reasoning that any increased price paid by some consumers is not efficiency-reducing, as long as other consumers can purchase the product at competitive rates. *See* Gideon Parchomovsky & Peter Siegelman, *Toward an Integrated Theory of Intellectual Propcrty*, 88 VA. L. REV. 1455 (2002).

430. An important caveat is that the reduction of deadweight loss is not solely a function of the auction revenues, as the firms' equilibrium output decisions will depend on issues like the shape of the firms' cost curves. Of course, this point provides a justification for flexibility once again, with the administrative agency making assessments of decreased deadweight loss primarily on the basis of auction results, but then making suitable adjustments to those results based on the particular characteristics of the firms.

government can compensate for the latter with greater dollar payments.

The principal advantage of this proposal is that it eliminates much of the gamesmanship that Kremer's proposal risks. There remains a danger of bribery, as firm *A* might be willing to give firm *B* extra money with which to supplement its bid, recognizing that if *B* wins, *A* will receive this money back, plus receive more money from the government. The impact of bribery, however, is reduced, because any excess money bid must be paid all of the time rather than just some fraction of the time. Moreover, because all auctions are consummated, the risk of implicit collusion, which is likely to be more difficult to detect than explicit collusion, is greatly reduced.[431] Finally, the government could largely eliminate both problems in an auction with multiple winning competitors by keeping individual bids secret. A patent holder could try to bribe more than one of the bidders, but each bidder would have an incentive to renege, since the patent holder would not be able to determine which bidder had done so.[432] This approach is not possible with Kremer's proposal, because his auctions would have only one winner.

The principal disadvantage of this proposal relative to Kremer's is that it cannot achieve a competitive result. If having one hundred competitors would bring the price of the product down to marginal cost, then no one would be willing to pay anything for the right to be one of those competitors, so the proposal can only work where the number of competitors will still leave the price above the competitive level. This disadvantage, however, is not serious if the government is willing to spend only a limited amount of money on a patent prize system. Indeed, the proposal may be a useful way of encouraging a modest reduction in price across a relatively large

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431. For the same reason, the problems related to complementary products are eliminated. *See supra* notes 145-46 and accompanying text. No one would bid on the right to license a drug that is useless except as part of a three-drug cocktail, if the patent holder retained patents over the other two drugs, because the patent holder would have an incentive to sell the auctioned drug at a competitive price and obtain monopoly profits from the patent still under patent protection.

432. A patent holder might try to overcome this obstacle by demanding that a patent holder show it a cancelled check representing its payment. The government, however, could overcome this strategy by allowing bidders to send in excess payment and then requesting a refund that others would not he informed about. Interestingly, this is precisely the approach that Ayres, writing with Jeremy Bulow, takes in an analogous context, explaining how the government could keep campaign donations anonymous. *See* Ian Ayres & Jeremy Bulow, *The Donation Booth: Mandating Donor Anonymity to Disrupt the Market for Political Influence*, 50 STAN. L. REV. 837, 859-60 (1998) (suggesting a system that would allow nondonors to mimic donors). Another way of making bribery more difficult would be to have all winners pay the bid of the winner with the lowest bid, as on many auction sites, or to have all winners pay the bid of the loser with the highest bid, as in a second-price sealed bid auction. *See supra* note 125.

number of products, instead of a large reduction in price across a small number of products. Total social welfare increases might be larger with this approach, because the last increment in monopoly pricing does the most harm.[433] If the government were to offer $1 billion, to be distributed in proportion to auction revenues to companies opting into the duopoly auction, then a large number of firms likely would make sacrifices in reduced monopoly profits of close to this amount to receive portions of the fund in return, but the corresponding increase in social welfare should be considerably greater than the fund. Only if the government is determined to eliminate deadweight loss completely in a particular market altogether does the duopoly or oligopoly auction cease to be a viable approach.

4. Prizes for Coupons

Lichtman's proposal for the donation of coupons to relatively low-income consumers might benefit the most from increased flexibility. A principal aim of providing government-supplied coupons was to induce the patent holder to lower prices, and a government agency with poor information about individuals' willingness to pay for a patented product might fail to induce the appropriate price shift. The government in Lichtman's proposal thus makes a decision in anticipation of an appropriate response from a patent holder, but then does not penalize the patent holder if it fails to make the expected response. This problem vanishes if the patent holder provides the coupons itself to low-income individuals and then lowers the price of its product, expecting the government ex post to reward it for the resulting decrease in deadweight loss. This outcome is possible in a flexible prize system, in which the government estimates the deadweight loss reduced instead of issuing the coupons itself.[434] One virtue of this approach is that it helps answer a criticism Kremer levied against Lichtman, that if the government could price discriminate, the patent holder presumably could as well.[435] Sometimes price discrimination might be expensive to achieve—for

433. *See, e.g.*, Ayres & Klemperer, *supra* note 183, at 989 ("[T]he last increment by which an unconstrained patentee chooses to increase price hurts society much more than it helps the patentee.").

434. The government also might assist in distributing coupons if the government wishes to allow the patent holder to take advantage of its information without raising privacy concerns. *See supra* note 161 and accompanying text. For example, the government might agree to distribute coupons to all individuals whose tax returns indicate income below a certain threshold, without informing the company of the names of these consumers.

435. *See supra* note 160 and accompanying text.

example, if income or medical condition needs to be verified—and because the patent holder is no worse or better off in the hypothetical coupon system administered by a government with perfect information, the patent holder has no incentive to incur these costs. But if the patent holder receives not only the same revenue from consumers as before, but also a prize from the government for the decrease in deadweight loss, it will be willing to invest in price discrimination as long as it is cost justified.

Measuring the decrease in deadweight loss may be difficult, especially because the government may not be able to determine what the monopoly price would have been. This Article's argument for flexibility suggests that any errors in calculating deadweight loss may not be serious, but the government also might use a coupon system to estimate the reduction in deadweight loss quite closely. Suppose the face of each coupon did not reveal its value. The patent holder then might ask potential users of the drug to send their coupons with checks for the maximum amount that they are willing to pay for the drug. If the sum of a check and the coupon face value were at least the price of the drug, the company would send the drug (or a full coupon to receive it in a pharmacy) plus a refund for the price difference; otherwise, the company would simply send back the check. This would allow precise calculations of consumer surplus of those receiving the drug and of deadweight loss from those whose combined check and coupon offer was too low. Perhaps this system is too strange to be implemented; consumers surely would be puzzled by it. The hypothetical solution, however, shows that information revelation mechanisms may help the government calculate patent prizes and that there may well be less alien information revelation mechanisms that similarly could help the government estimate reductions in deadweight loss. Some combination of such mechanisms and allowance for governmental agency flexibility might provide the best approach to perfecting patent prizes.

IV. CONCLUSION

Proponents of patent prizes have sought to avoid the deadweight losses associated with intellectual property protection by recommending that a centralized governmental spending program replace a market-based incentive. In seeking formulaic or algorithmic approaches to patent prizes, these scholars implicitly have recognized public choice concerns about the government's ability to make wise spending decisions. In this Article, my concern has been less with the benefits that a governmental spending program has over the market

than with the benefits that a retrospective prize system has over a typical governmental spending program. Concerns that government will misspend money, either through individual decisionmakers' incompetence or as a result of influence, are understandable. Public choice and administrative law scholars have long focused on how to overcome these problems, considering antidotes such as separation of powers and judicial review. But they have ignored the virtues of flexible, retrospective decisionmaking. With a carefully designed prize system, even if an individual decisionmaker makes an error or is influenced by political considerations in calculating a prize, these flaws will not affect the decisions that matter—those made in anticipation of the eventual governmental awards.