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The Case for Tax: A Comparative Approach to Innovation Policy

ABSTRACT. The federal government deploys a variety of institutions—patent, tax, and spending, among others—to encourage innovation. But legal scholars have given short shrift to how these institutions should be coordinated. In this Note, I argue that tax credits could be used to ameliorate a number of inefficiencies that arise from the failures of patent law. Deploying strong tax credits narrowly could improve incentives for small businesses and in emerging industries at a relatively low cost. I argue that this style of comparative institutional analysis should be part of every innovation scholar's toolbox.

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NOTE CONTENTS

INTRODUCTION

How should the federal government encourage innovation in the United States? Policymakers have a menu of choices at their disposal. They can give cash grants, issue patents, offer prizes, or provide tax breaks. But when legal scholars set about answering the question, they tend to focus on their areas of expertise. Intellectual property scholars typically talk about patent scope or duration, the doctrine of equivalents, and disclosure requirements.[1] Tax scholars argue that research tax credits should be larger, permanent, or more easily accessible.[2] Sometimes these scholars acknowledge that their chosen institution should treat different technologies or industries differently.[3] But how to deploy an institution—patent, tax, or spending—to encourage innovation should be the *second* question we ask. The initial, oft-overlooked[4]

1. A survey of all the patent-focused innovation literature would be impossible. Here I focus on recent, prominent examples where institutional alternatives could have been promising but were largely or completely ignored. *E.g.*, Michael Abramowicz, *The Uneasy Case for Patent Races over Auctions*, 60 STAN. L. REV. 803 (2007); Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575 (2003); Michael W. Carroll, *One Size Does Not Fit All: A Framework for Tailoring Intellectual Property Rights*, 70 OHIO ST. L.J. 1361, 1404 (2009) (proposing patent law tailoring); Julie E. Cohen & Mark A. Lemley, *Patent Scope and Innovation in the Software Industry*, 89 CALIF. L. REV. 1 (2001); Jeanne C. Fromer, *Claiming Intellectual Property*, 76 U. CHI. L. REV. 719 (2009); Tim Wu, *Intellectual Property, Innovation, and Decentralized Decisions*, 92 VA. L. REV. 123 (2006); Richard A. Posner, *Patent Trolls Be Gone: How to Fix Our Broken System for Stimulating Invention*, SLATE (Oct. 15, 2012, 5:16 PM), http://www.slate.com/articles/news_and_politics/view_from_chicago/2012/10/patent_protection_how_to_fix_it.html.

2. *E.g.*, Robert D. Atkinson, *Expanding the R&E Tax Credit to Drive Innovation, Competitiveness and Prosperity*, 32 J. TECH. TRANSFER 617 (2007); Calvin H. Johnson, *Capitalize Costs of Software Development*, 124 TAX NOTES 603 (2009); William Natbony, *The Tax Incentives for Research and Development: An Analysis and a Proposal*, 76 GEO. L.J. 347 (1987); Evan Wamsley, Note, *The Definition of Qualified Research Under the Section 41 Research and Development Tax Credit: Its Impact on the Credit's Effectiveness*, 87 VA. L. REV. 165 (2001).

3. *E.g.*, Burk & Lemley, *supra* note 1, at 1581-89, 1675-96; Carroll, *supra* note 1, at 1395-96; Posner, *supra* note 1.

4. Three exceptions to this trend are worth noting. The first is an article by Brett Frischmann, *Innovations and Institutions: Rethinking the Economics of U.S. Science and Technology Policy*, 24 VT. L. REV. 347 (2000). In his article, Professor Frischmann begins with the same theme as in this Note: that we should engage in institutional comparisons when evaluating innovation policy. He describes the institution of tax at some length. *Id.* at 382-85. But Professor Frischmann does not explore the innovation environments in which tax is preferable to patent; his in-depth example focuses on a mix of grants and intellectual property. *Id.* at 395-413.

question is the following: which institution (or mix of institutions) should we use in the first place?

This oversight is surprising for the simple reason that the stakes are so high. Federal research and development tax incentives total more than $10 billion annually;[5] the rents that patent holders collect are hard to estimate, but they probably top $30 billion every year;[6] and the National Institutes of Health (NIH) alone distributed over $30 billion for medical research in 2012.[7] These cash and cash-equivalent distributions—which drive much of the research that fuels the U.S. economy—often have overlapping targets. Yet the subsidies themselves, the way they are allocated, and the institutions that distribute them are substantially different. These differences should inform our choice of how to encourage innovation.

To illustrate, consider the emerging technology of DNA computing.[8] There

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The second exception is the economics literature, which has given significant thought to comparing patents to prizes. *E.g.*, Nancy Gallini & Suzanne Scotchmer, *Intellectual Property: When Is It the Best Incentive System?*, *in* 2 INNOVATION POLICY AND THE ECONOMY 51 (Adam B. Jaffe, Josh Lerner & Scott Stern eds., 2002) (reviewing the justifications for intellectual property and the case for prizes); Steven Shavell & Tanguy van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525 (2001) (arguing for an optional patent-prize hybrid system); E. Glen Weyl & Jean Tirole, *Market Power Screens Willingness-to-Pay*, 127 Q.J. ECON. 1971 (2012) (modeling the optimal combination of patents and prizes).

Third, a forthcoming work by Daniel Hemel and Lisa Ouellette explores the interplay between patents, prizes, tax credits, and grants. Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents-Prizes Debate*, 92 TEX. L. REV. (forthcoming 2013), http://ssrn.com/abstract=2245691. They argue that each of these institutions can theoretically achieve similar results. *Id.* (manuscript at 8). They go on to establish a three-part framework for characterizing innovation subsidies: who decides the size of the reward, when the reward will be provided, and who pays for the reward. *Id.* (manuscript at 19). While we reach some different conclusions, *compare id.* (manuscript at 4) (disfavoring tax credits for technology fields populated by startups), *with infra* Sections II.C, II.D (arguing for the use of tax credits in emerging technology fields), their descriptive model tends to support the suggestions I put forward in this Note.

5. STAFF OF JOINT COMM. ON TAXATION, 113TH CONG., ESTIMATES OF FEDERAL TAX EXPENDITURES FOR FISCAL YEARS 2012-2017, at 30 tbl.1 (Joint Comm. Print 2013).

6. *See* JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 114 (2008). This estimate is actually based on inflation-adjusted data from 1999. *Id.*

7. *NIH Budget*, NAT'L INSTS. HEALTH (Sept. 18, 2012), http://www.nih.gov/about/budget.htm.

8. *See generally* David I. Lewin, *DNA Computing*, COMPUTING SCI. & ENGINEERING, May/June 2002, at 5 (providing an introduction to DNA computing); *DNA Computing: Computing*

are several potential advantages to using DNA to store data and conduct computations.[9] The research is still mostly of the basic variety, although commercial entities have started to show some interest.[10] How should the government encourage this nascent research as it becomes commercially viable? One of the arguments that I will make in this Note is that the patent system may be a poor fit for such a field. For instance, the patentability of a DNA computer—and the computer's related interactions with human cells—seems presently uncertain.[11] The eventual patentability determinations will lag the technology by decades and will not necessarily be motivated by sound policy rationales.[12] Moreover, the patent system might underfund such early-stage research, as many of the developments—while critical to charting the field—will not themselves yield any commercially viable products. This decreases the

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with Soup, ECONOMIST, Mar. 3, 2012, http://www.economist.com/node/21548488 (describing the history of the field).

9. The original proof-of-concept experiment from 1994 demonstrated that DNA computing could be faster and more energy efficient than existing supercomputers. Leonard M. Adleman, *Molecular Computation of Solutions to Combinatorial Problems*, 266 SCIENCE 1021, 1023 (1994). DNA can also store more information per unit of space than any extant hard drive system. *See* George M. Church, Yuan Gao & Sriram Kosuri, *Next-Generation Digital Information Storage in DNA*, 337 SCIENCE 1628 (2012); Nick Goldman et al., *Towards Practical, High-Capacity, Low-Maintenance Information Storage in Synthesized DNA*, 494 NATURE 77 (2013). Perhaps most importantly, DNA computers can operate within human cells, and thus could yield significant medical benefits. *See DNA Computing: Computing with Soup*, *supra* note 8.

10. Microsoft is hiring. *See Research Opportunities in Biological Computation*, MICROSOFT RES. (Jan. 28, 2011), http://research.microsoft.com/en-us/groups/biology/jobs.aspx. Quantum computing, DNA computing's more famous cousin, is a bit further down the commercialization path. *See* Cade Metz, *Google's Quantum Computer Proven to Be Real Thing (Almost)*, WIRED (June 28, 2013, 6:30 AM), http://www.wired.com/wiredenterprise/2013/06/d-wave-quantum-computer-usc.

11. The recent Supreme Court decision on the topic makes it more likely that synthetic, non-naturally occurring DNA constructions would be patentable. *See* Ass'n for Molecular Pathology v. Myriad Genetics, 133 S. Ct. 2107 (2013). But DNA computing would likely challenge this synthetic/natural binary, as it usually involves interactions between artificial networks and natural processes. *See, e.g.*, Zhen Xie et al., *Multi-Input RNAi-Based Logic Circuit for Identification of Specific Cancer Cells*, 333 SCIENCE 1307 (2011) (describing a synthetic genetic circuit that could discriminate cancerous from non-cancerous cells by measuring intracellular microRNA concentrations and could trigger natural cell death in cancerous cells); *see also Biological 'Computer' Destroys Cancer Cells: Diagnostic Network Incorporated into Human Cells*, SCIENCEDAILY (Sept. 2, 2011), http://www.sciencedaily.com/releases/2011/09/110901142056.htm (summarizing the research).

12. *See infra* Section II.D.

value of patenting such discoveries.[13] Other subsidy systems are not so limited; research tax credits, for example, are distributed ex ante regardless of commercial success. Moreover, the institution overseeing the tax system has the data-gathering tools to make informed decisions about qualifying research. As will be discussed throughout this Note, these advantages recommend using the tax system to fund emerging technologies like DNA computing.

The thesis of this Note is that tax may be a more effective driver of innovation than previously recognized. But my suggestion is not an across-the-board increase in tax credits. Rather, I will recommend that Congress should reallocate the $10 billion in annual research tax expenditures to more narrowly target those domains where tax is most effective. To get to this conclusion, I will compare the institutions of patent and tax, and argue that the strengths of tax complement the weaknesses of the patent system. My suggestion is that Congress should focus its tax expenditures on those areas of research where patents fail and tax excels.

While my analysis will hopefully demonstrate the value in a comparative institutional analysis, I admit that I am not taking on the choice-of-institution question in its entirety. I am focusing on tax's strengths relative to patents—and largely ignoring grants and prizes—for a variety of reasons. First, patent and tax are the two institutions primarily focused on encouraging commercial research. Grants fill a different niche, as they tend to be directed at basic, university investigations. Second, neither patent nor tax requires that government officials decide ex ante whether or not any particular research qualifies for the subsidy. Federal grant programs involve scientist-officials approving promising research before it takes place. Traditional prizes require some upfront goal specifications. There are plausible arguments that this style of top-down directed research is inefficient.[14] Third, the case for prizes, in particular, has already been made.[15] Notwithstanding these cogent arguments, the federal government has shown little inclination to convert to a prize-oriented system of innovation subsidies.[16] By contrast, the government is extremely comfortable distributing tax subsidies to promote favored types of research. Thus, by focusing on tax, I hope to make a series of suggestions that might actually be implemented by the federal government. Finally, as I hope

13. *See infra* Section II.C.

14. *See infra* notes 125-126 and accompanying text.

15. *E.g.*, Shavell & van Ypersele, *supra* note 4; Weyl & Tirole, *supra* note 4.

16. For a discussion of the recent public and private attempts to use prizes, see Hemel & Ouellette, *supra* note 4 (manuscript at 11-13).

to show in this Note, patent and tax are complementary in many respects. Comparing these institutions illustrates their advantages and limitations. I leave for another day the question of whether prizes and grants have similar strengths and weaknesses and how they could be added to the institutional mix.

Part I of this Note lays the groundwork necessary for my argument: first, by explaining the economic logic for government subsidies to innovation; and second, by describing how patent and tax affect social welfare by encouraging more optimal research decisionmaking.

Part II analyzes several specific advantages of tax subsidies relative to the patent system. Along with exploring tax's comparative benefits, I describe the innovation environments in which these advantages are particularly important. I identify four considerations that should inform a choice between patent and tax when the government's goal is to foster socially beneficial research decisions. (Table 1 offers a summary.) The first important difference between tax and patent is tax's relatively low administrative cost. When inventors are filing low-value or multiple patents, these lower administrative costs will make tax comparatively efficient in encouraging innovation. The second difference is subsidy timing. In situations where credit markets are imperfect, tax's upfront payments ease the burden of research costs, which is particularly valuable for small inventors. The third difference is tax's reward for risk taking. When failure is valuable, tax may be preferable. The fourth and final point is institutional: tax's rewards are more flexible and immediate, while patent is perhaps more predictable over a longer time frame. These differences favor tax in situations of technological change and emerging industries. Implementing the changes that flow from these observations could dramatically improve the productivity of hitherto neglected research environments while simultaneously cutting the costs of duplicative subsidies.

Table 1.
FOUR DIFFERENCES BETWEEN PATENT AND TAX

	Tax	Patent
Cost to Administer	Low	High
Subsidy Timing	Ex ante	Ex post
Rewards for Risk Taking	Subsidizes experimentation	Subsidizes success
Institutional Character	Flexible	Stable

I. INNOVATION SUBSIDIES AND SOCIAL WELFARE

A. *Why Subsidize Research?*

Innovations are slippery things. Sometimes they come unexpectedly and effortlessly, like a bolt in the night. But other times they are the product of systematic, careful investigation. This Note is concerned with how government policymakers should best stimulate such research-driven innovations. But first we must ask the prior question: why should we be encouraging research at all?

Even in a world without any government help, entrepreneurs would still investigate new technologies.[17] Indeed, many of the most important inventions in history have sprung forth without much or any meddling from the government.[18] Nevertheless, there are good arguments in favor of subsidizing research. Perhaps the best reason is that research can produce spillover benefits—positive externalities benefiting someone other than the inventor.[19] These are benefits that the researcher herself cannot appropriate. Consider, for example, Ford Motor Company's development of the moving assembly line in the early twentieth century. To be sure, Ford made a handsome profit from this innovation—it was able to make cars much more cheaply. However, the value of this innovation far exceeded the value to Ford Motor Company alone. Other manufacturers soon imitated Ford's improved process, which allowed them to also use their capital and labor more efficiently.[20] In the parlance of innovation theory, we can say that Ford was unable to appropriate the full value of its innovation.

As a general rule, individuals will engage in research when the research's expected value—to the inventor—is greater than the research's costs. But when researchers cannot appropriate the full value of their innovations, those

17. Inventors are able to profit from their discoveries even absent patent protection via mechanisms like trade secret, first-mover advantages, branding, and market barriers. *See* Frischmann, *supra* note 4, at 367-70; Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development*, 3 BROOKINGS PAPERS ON ECON. ACTIVITY 783, 794 (1987).

18. *See generally* MICHELE BOLDRIN & DAVID K. LEVINE, AGAINST INTELLECTUAL MONOPOLY 52-67 (2008).

19. Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 258-61 (2007).

20. DAVID A. HOUNSHELL, FROM THE AMERICAN SYSTEM TO MASS PRODUCTION, 1800-1932, at 11 (1984).

innovations may be underproduced.[21] This is a critical point that motivates most government expenditure on research. Imagine that an executive at Ford is deciding whether to spend money researching an assembly line. She estimates that the company could undertake a project costing $100,000 that would yield a 50% probability of producing a productivity-enhancing process that could earn the company $150,000. As a profit maximizer, she will reject this research plan because it yields an expected loss of $25,000. But what if the research, if successful, would also earn Ford's competitors $150,000 worth of productivity enhancements? Then, society's expected value from the research would total $150,000. Since that is more than the $100,000 cost of the research, society would prefer that Ford undertake the research. For the purposes of this Note, I will assume that research decisionmaking is "optimal" when inventors engage in research whenever the total research costs are less than or equal to the expected total social welfare produced by the research.[22] The reason we subsidize research is to bridge the gap between an individual inventor's expected value and society's expected value: in the example above, society should be willing to spend up to $75,000 to encourage Ford to undertake the research.

There are many ways society could encourage Ford to engage in more optimal decisionmaking. The Constitution puts forward one solution in the Patent and Copyright Clause,[23] and patents do present an elegant way of allowing Ford to appropriate much of the value of the assembly line. But Congress could also rebate some portion of Ford's research costs—this is the basic approach of Congress's research tax credit. Congress could also fund the research directly—this is the approach embodied in, for example, NIH grants to private researchers. Or Congress could award a prize to the first team to develop an assembly line. The basic point is this: there is an institutional choice

21. Of course, full appropriability may also overcompensate researchers where they would have undertaken their research for less. This adds to the deadweight cost of government subsidies, but it does not remove the possibility that natural market mechanisms will fail to bring about some social-welfare-enhancing lines of research.

22. I acknowledge that a system that achieves this "optimal" state will be inefficient in other ways—for example, by overcompensating some researchers or by imposing distortions that outweigh the marginal social benefits of the extra subsidies.

23. U.S. CONST. art. I, § 8, cl. 8. Of course, patents do not involve direct expenditures, but rather impose an indirect cost on society via higher prices of patented products. The patent system essentially gives Ford a 50% chance at an extra $150,000, which is equivalent to an ex ante subsidy of $75,000.

Congress has to make about how best to encourage innovation.[24] A full comparison of all these alternatives is desirable but beyond the scope of this Note. Here I focus on a pairing that has been largely overlooked in the innovation literature[25]: patent protection and the research tax credit. I will argue that various features of the patent and tax systems make tax particularly attractive under certain innovation conditions. We shall see that tax may be the most sensible legal vehicle for encouraging innovation when the research produces many inventions, has a long commercialization period, or is in an emerging field. Tax may also be the preferred approach for helping lone inventors and small businesses, or when the industry is diffuse and difficult to monitor.

B. Patents

The patent system attempts to spur innovation by granting researchers a right to exclude others from using their invention, which provides the researchers with a temporary monopoly on their discoveries.[26] With this monopoly, a researcher can earn a "patent subsidy" by charging more for products that use the invention or by licensing the invention to her competitors.[27] In effect, society is subsidizing the invention by way of higher prices. To be patentable, an invention must be novel, useful, and non-obvious.[28] It must also be a process, machine, manufacture, or composition of matter.[29] A patent holder can sue infringers[30] to enjoin their use and to recover damages.[31] The great benefit of the patent system is that it more closely aligns an inventor's expected value in doing research with society's total expected

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24. For a more formal exploration of the optimal funding levels under these different regimes, see Hemel & Ouellette, *supra* note 4 (manuscript at 23-25).

25. *See supra* notes 1-2.

26. The current patent term is twenty years. 35 U.S.C. § 154(a)(2) (2006).

27. For an excellent discussion of the economic fundamentals of intellectual property and patents, see Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 993-99 (1997).

28. 35 U.S.C. § 101 (utility); *id.* § 102 (novelty); *id.* § 103 (non-obviousness).

29. *Id.* § 101 (patentable categories).

30. *Id.* § 271 ("[W]hoever without authority makes, uses, offers to sell, or sells any patented invention . . . infringes the patent.").

31. *Id.* §§ 283-284.

value from that research.[32] Harkening back to the example in the previous Section, a patent would allow Ford to charge its competitors to use the assembly line. In a perfect market, Ford would earn an extra $150,000, which would equalize Ford's expected value and the expected value to society. The patent system succeeds in aligning social welfare with research incentives when socially valuable ideas—with patent protection—command large profits or high licensing fees. To be sure, patent does not operate to maximize social welfare in all cases: some discoveries, like surgical checklists, are notoriously hard to monetize even with patent protection, and these goods will be systematically underproduced without other subsidies.[33] Nevertheless, the patent system does succeed at providing significant subsidies for inventions of large social value that would otherwise be underproduced.

In exchange for these handsome rewards, the patent system demands a quid pro quo[34]: inventors seeking patents must disclose their invention publicly.[35] Disclosure ensures that the invention can be easily reduced to practice by the public at the end of the patent term.

A final notable feature of the patent system is that it harnesses the inventor's own knowledge about the value of the research.[36] Government regulators do not need to vet the project ahead of time. Rather, the inventor decides what she thinks will be the most profitable course of research. This is an advantage because we assume that researchers are best situated to evaluate the probability of success and the commercial viability of their research agenda. By exploiting this privately held knowledge, the patent system avoids the costly and duplicative bureaucracy of direct government funding.

Through the mechanisms described above, the patent system aims to improve social welfare by producing innovations that would not otherwise have come about. However, the patent system also involves several drawbacks. It imposes deadweight loss via monopoly pricing: some consumers who would

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32. *See* Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 276-79 (1977).

33. Amy Kapczynski & Talha Syed, *The Continuum of Excludability and the Limits of Patent*, 122 YALE L.J. 1900, 1937-41 (2013). Professors Kapczynski and Syed further argue that the patent system exacerbates this under-provision since it allocates scarce resources to the most excludable information goods. *Id.* at 1915.

34. Eldred v. Ashcroft, 537 U.S. 186, 216 (2003) ("[I]mmediate disclosure . . . is exacted from . . . the patentee. It is the price paid for the exclusivity secured.").

35. *See* 35 U.S.C. §§ 111(a)(2)(A), 112.

36. *See* Joseph E. Stiglitz, *Economic Foundations of Intellectual Property Rights*, 57 DUKE L.J. 1693, 1721-22 (2008).

be willing to pay the competitive price of a good (i.e., the price without any patent protection) will not buy at the monopoly price; this missed exchange is a social welfare loss.[37] Additionally, patents can hinder innovation by other researchers, who will have to pay licensing fees and may be excluded altogether from using patented ideas to further their own research.[38] Because of these substantial costs—which are incurred even for inventions that would have emerged without patent—policymakers should only seek to distribute patent protection to the extent necessary to optimally stimulate research.

Two additional details are worth noting. First, implementing the patent system has administrative costs, which include filing fees and enforcement costs, among others. This is an oft-overlooked impediment to patent law achieving optimal efficiency to which we'll return in Section II.A. Second, the patent system only operates on successful inventions. Patent does not allow any appropriation of experimental failures that benefit society. I will address this distortion in Section II.C.

C. Tax

The federal government also uses tax incentives to improve social welfare by stimulating research. These incentives reduce researchers' tax bills proportionally to the amount they spend on qualified research. The intricacies of how these tax incentives are calculated are somewhat complex and not critical to my argument in this Note. Here I merely provide an overview.[39]

The two major federal tax incentives for research are a tax deduction[40] and a tax credit.[41] The research tax deduction allows taxpayers to treat research or experimental costs related to a trade or business as a current expense.[42] Thus, if

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37. Shavell & van Ypersele, *supra* note 4, at 529.

38. *See* Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, *in* 1 INNOVATION POLICY AND THE ECONOMY 120 (Adam B. Jaffe, Josh Lerner & Scott Stern eds., 2000).

39. For an extremely helpful and extensive discussion of the research incentives in the federal tax code, see generally MICHAEL D. RASHKIN, RESEARCH AND DEVELOPMENT TAX INCENTIVES: FEDERAL, STATE, AND FOREIGN (2003).

40. I.R.C. § 174 (2012).

41. *Id.* § 41.

42. *Id.* § 174(a)(1). Typically, expenditures providing benefits for more than a year (as research expenditures do) would need to be capitalized and would not be immediately deductible from income. Treating research expenditures as a current expense provides taxpayers with a

Ford spends $100,000 on research in 2013, it can immediately reduce its net income by $100,000, which, if Ford has a marginal tax rate of 35%, would reduce its tax bill by $35,000. The most significant restriction on the deduction is that it must be for expenditures that are "research and development costs in the experimental or laboratory sense," which has been further interpreted to mean costs related to scientific research and analysis that is intended to mitigate the uncertainty surrounding the development of an innovative product.[43]

The second major federal tax subsidy for research is the research credit. Congress enacted this credit in 1981,[44] a time when U.S. research expenditures were decreasing when measured against the growth of the broader U.S. economy.[45] The credit equals twenty percent of the increase in a taxpayer's qualified research expenses for the taxable year over a base amount.[46] The base amount is the product of a fixed-base percentage—the percentage of the taxpayer's total gross receipts spent on qualified research averaged over a set period during the 1980s—and the average annual gross receipts in the prior four taxable years.[47] So if Ford's gross income remains the same and it spends $100,000 more on research in 2013 than it had in the previous four years, the amount of taxes it owes would be decreased by $20,000.[48]

Research expenses that qualify for the tax credit include wages paid to an employee engaged in qualified research as well as the expenses for supplies used in that research.[49] For the research to qualify for the credit, it must meet three criteria beyond the requirements for the deduction. First, the research must be undertaken for the "purpose of discovering information . . . which is technological in nature."[50] Second, the research activities must "constitute

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major benefit. *See* MICHAEL J. GRAETZ & DEBORAH H. SCHENK, FEDERAL INCOME TAXATION: PRINCIPLES AND POLICIES 295-301 (6th ed. 2009).

43. Treas. Reg. § 1.174-2(a)(1) (2012).

44. Economic Recovery Tax Act of 1981, Pub. L. No. 97-34, 95 Stat. 172 (codified as amended in scattered sections of 26 U.S.C.).

45. RASHKIN, *supra* note 39, ¶ 315.

46. I.R.C. § 41(a). Section 41 also subsidizes other activities, such as basic research and energy research expenditures; these subsidies are not considered in this Note.

47. *Id.* § 41(c).

48. A company that claims the research tax credit must reduce their research deduction by the credit amount. *Id.* § 280C(c)(1). So in this example, Ford would need to reduce the deduction from $100,000 to $80,000.

49. *Id.* § 41(b)(2)(A).

50. *Id.* § 41(d)(1)(B).

elements of a process of experimentation."[51] Third, the research must be intended to improve the function, performance, quality, or reliability of a business component.[52] A "business component" is defined as a "product, process, computer software, technique, formula, or invention which is to be held for sale, lease, or license, or used by the taxpayer in a trade or business of the taxpayer."[53] These determinations are made by the taxpayer herself—she does not need to have the research approved in advance to claim the credit (or deduction), although she will have to provide sufficient documentation should she be audited.[54]

The scope of these research tax subsidies is larger than the scope of patent protection. IRS regulations have established a patent safe harbor: the issuance of a patent is "conclusive evidence that a taxpayer has discovered information that is technological in nature that is intended to eliminate uncertainty concerning the development or improvement of a business component."[55] This safe harbor does not cover every element of the three-part test described above.[56] Thus, there may be a small class of inventions that can be patented but whose research expenditures would not qualify for the tax subsidies. For instance, one might imagine patentable inventions that wouldn't qualify as a business component because they will not be used in the taxpayer's trade or business. However, these will be unusual instances,[57] and perhaps they are not the sort of discoveries that need to be subsidized at all. On the other hand, huge swaths of non-patentable research qualify for tax subsidies in any case. The IRS has noted that a patent is not a prerequisite for claiming the research tax credit.[58] Of particular note, research need not be a success to qualify for the

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51. *Id.* § 41(d)(1)(C).

52. *Id.* § 41(d)(1)(B)(ii).

53. *Id.* § 41(d)(2)(B).

54. *See* RASHKIN, *supra* note 39, ¶¶ 801-15 (discussing the documentation requirements and audit procedures for the research tax credit).

55. Treas. Reg. § 1.41-4(a)(3)(iii) (2012).

56. *See* RASHKIN, *supra* note 39, ¶ 440.01 (noting that the patent safe harbor only applies to the discovery requirement).

57. *See id.* (arguing that practically any inventor whose invention qualifies for a non-design patent will also have engaged in qualified research for the purposes of the research tax credit).

58. Treas. Reg. § 1.41-4(a)(3)(iii).

credit; moreover, the taxpayer need not be the first to make a discovery for the research to qualify.[59]

Much like the patent system, tax aims to improve social welfare by producing innovations that would not otherwise have been discovered. Instead of increasing appropriability directly, the tax system provides a cash rebate to the researcher by decreasing her tax bill. Ideally, this credit would equal the difference between the expected value of the research to the inventor and the expected value of the research to society. An important feature of tax—which is both a weakness and a strength—is that the size of the credit is easy to manipulate. This is a weakness because it creates the possibility a researcher could receive an inefficiently large or small credit. But it is a strength because it allows policymakers to tailor the tax credit to accommodate differences in innovation environments.

However, distributing research credits[60] also has a social cost. The social welfare cost of the tax credit depends on the nature of the tax that is used to collect funds to pay for the credit. Highly distortionary taxes will impose greater social costs,[61] and the larger the distributed credits, the greater those costs.[62] Thus, much like for patent, we should only aim to distribute research tax credits to the extent that they are most likely to produce social welfare-improving research.

II. AN INSTITUTIONAL COMPARISON

As the preceding Part suggests, patent and tax can both contribute to social welfare by encouraging innovation. But the two regimes are strikingly different. In this Part, I explore four important differences: administrative

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59. Credit for Increasing Research Activities, T.D. 8930, 66 Fed. Reg. 280-01 (Jan. 3, 2001) ("The clarifications that the credit may be available where the technological advance sought is evolutionary, where the taxpayer is not the first to achieve the advance, and where the taxpayer fails to achieve the intended advance have been incorporated elsewhere in the regulations.").

60. For the purposes of this Note, I will refer mainly to the research tax credit, but most of the logic can be applied similarly to the research tax deduction.

61. The distortionary effects of, for example, income taxation will largely turn on the elasticity of the labor supply being taxed. *See* Greg Mankiw, *How Distortionary Are Taxes?*, GREG MANKIW'S BLOG (Nov. 27, 2006), http://gregmankiw.blogspot.com/2006/11/how-distortionary-are-taxes.html.

62. For an interesting discussion of who should bear the cost of research subsidies, see Hemel & Ouellette, *supra* note 4 (manuscript at 39-45).

costs, subsidy timing, rewards for risk taking, and institutional character. These differences suggest that we could more optimally encourage innovation by reconfiguring the patent/tax balance of the status quo. Deploying stronger tax subsidies for innovation in a few particular research environments would yield better research decisions at low additional costs.

A. Administrative Costs

Administrative costs are costs borne by the inventor that are not related to actually doing the research. These are costs that only come about from the inventor trying to obtain the subsidy. The paradigmatic administrative cost is hiring a lawyer to write a patent application or an accountant to prepare a tax return. Other administrative costs include filing fees and litigation costs associated with defending the patent or tax return. Administrative costs are problematic because they deter socially desirable research that would otherwise be undertaken. This occurs when the expected value of the research is greater than the research's costs—perhaps in part because of a government subsidy—but the administrative costs incurred in obtaining the subsidy flip this relationship such that total costs exceed expected value.

Both the patent and tax systems include many such costs. But in this Section I will argue that the expenses of filing and defending patents impose burdens on certain types of research that tax subsidies largely avoid. In particular, all else being equal, tax has a comparative advantage in subsidizing research that (1) yields many small inventions, (2) produces innovations that are costly to exclude competitors from using, or (3) has a low expected value. I will argue that we could promote more optimal research decisionmaking by using stronger tax credits for these research environments. Additionally, I will argue that the tax system is amenable to having its administrative costs reduced if policymakers see fit, which make it a strong choice in any domain where we think such costs are problematic.

1. Administrative Costs of Patent

There are, broadly, two sorts of administrative costs involved in using the patent system: prosecution costs and enforcement costs. Patent prosecution comprises the legal steps involved in initially obtaining the right to exclude. Typically this involves a lawyer searching for similar inventions that would invalidate the potential patent, a lawyer drafting the initial patent application to the Patent and Trademark Office (PTO) and responding to subsequent PTO actions, and the patentee paying the PTO's filing fees. It can also involve appellate review[63] and, with the passage of the America Invents Act, various forms of administrative litigation after the grant of the patent.[64] And, of course, the patentee often needs to secure patent protection in many other countries—there is no such thing as an international patent.[65]

Prosecuting patents is expensive. Collecting figures from several studies, Mark Lemley estimates that it costs between $10,000 and $30,000 to prosecute a patent in the United States from start to finish (where "finish" means patent issuance).[66] And these costs have little chance of decreasing. Indeed, most commentators argue that the PTO—which is notoriously slow and inaccurate in issuing patents—needs more funding, which would likely mean higher filing fees.[67] The current filing fee structure does give a fifty percent discount to small entities.[68] And the new America Invents Act—although it raises fees across the board by fifteen percent[69]—gives a further discount to "micro entities."[70] But these fee reductions do not diminish the impact of attorney

63. A patent applicant may appeal to the Patent Trial and Appeal Board after being twice rejected by a patent examiner. 35 U.S.C § 134(a) (2006).

64. For instance, third parties may challenge an issued patent in a procedure called "post-grant review" within nine months of issuance on any invalidity grounds. *Id.* § 321.

65. There is, however, a patent cooperation treaty that facilitates the initial filing and prior art search for 148 member countries. Patent Cooperation Treaty, June 19, 1970, 28 U.S.T. 7645, 1160 U.N.T.S. 231, http://www.wipo.int/pct/en/texts/pdf/pct.pdf; *PCT Resources*, WORLD INTELL. PROP. ORG., http://www.wipo.int/pct/en (last visited Oct. 24, 2013). However, this process is itself quite expensive, with cost estimates in the ballpark of $250,000. And the patent applicant must follow up a successful international application in each nation's own patent system. U.S. GEN. ACCOUNTING OFFICE, GAO-03-910, EXPERTS' ADVICE FOR SMALL BUSINESSES SEEKING FOREIGN PATENTS 42-43 (2003), http://www.gao.gov/new.items/d03910.pdf.

66. Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1498 & n.13 (2001).

67. *See id.* at 1495 n.1, 1508 nn.56-57.

68. Leahy-Smith America Invents Act, Pub. L. No. 112-29, § 11(d), 125 Stat. 284, 323 (2011) (to be codified at 35 U.S.C. § 41(h)). Small entities are businesses with fewer than 500 employees. 13 C.F.R. § 121.802(a) (2012).

69. Leahy-Smith America Invents Act § 11(i), 125 Stat. at 325.

70. *Id.* § 10, 125 Stat. at 316-17. Micro entities must be small entities and must be inventors on fewer than four previously filed patent applications. Among other requirements, they also must have an annual income less than three times the median U.S. income. *Id.* § 10, 125 Stat. at 318.

fees.[71] And even for small firms with simple patents, preparation costs are the lion's share of patent prosecution expenses.[72]

For a patent to have any value, though, it must be enforced. Patents give the patentee the right to sue infringers. Patent enforcement consists of the myriad activities after patent issuance that are required to maintain monopoly rights. These activities require payments including monitoring costs, which the patentee uses to stay abreast of both the public and private uses of her patented technology; negotiation costs, if the patentee wishes to license out her technology; litigation costs, should the patentee detect infringement; and PTO maintenance fees.

Estimates for the cost of patent enforcement are harder to come by since it is discretionary—that is, patent holders may choose to enforce their property rights a lot or not at all. Commentators rightly assume that these enforcement costs are high, though.[73] Costs related to monitoring vary based on industry size and composition. In industries with a few big players, or industries where sales and production are highly regulated, patent infringement should be fairly easy to observe. The canonical example is the pharmaceutical industry—because of the extensive monitoring by the FDA and the requirement for publicized studies validating treatments, a company like Merck would not need to spend much to find out if Pfizer is infringing one of its patents. On the other hand, in a diffuse industry such as computer programming, detecting patent infringement might require expensive investigation and constant vigilance.

While monitoring costs are significant but amorphous, litigation costs are simply significant. Very few patents ever get litigated after issuance,[74] but the ones that do cost about $800,000 to take through discovery and $1.5 million to

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71. *See, e.g.*, *Hearing on the U.S. Patent and Trademark Office Before the Subcomm. on Courts, the Internet, and Intellectual Prop. of the H. Comm. on the Judiciary*, 110th Cong. 108 (2008) (statement of Alan J. Kasper, First Vice President, American Intellectual Law Association) (estimating that the preparation of a simple patent application by his firm would cost $8,548 and that the preparation of a "relatively complex biotechnology/chemical" patent by such a firm would cost $15,398). At the time of Kasper's testimony, the filing fees for such an application were a little over $1,000. *Id.*

72. *See id.*

73. *See, e.g.*, Rebecca S. Eisenberg, *Patent Costs and Unlicensed Use of Patented Inventions*, 78 U. CHI. L. REV. 53, 55 (2011) ("The costliness of enforcement may thus lead both users and owners to ignore patents in many situations.").

74. Lemley, *supra* note 66, at 1501.

take through trial and appeal.[75] Any patentee wishing to credibly threaten a patent infringement lawsuit must be ready to shoulder this burden.

These administrative costs are all multiplied if the patentee wants international protection. Monitoring is obviously more expensive when infringement can be occurring across the globe. International patent litigation is increasingly common and incredibly expensive, as evidenced by the Apple-Samsung litigation over the design of those companies' smartphones, which, as of 2011, spanned nine countries.[76] And prosecuting patents internationally is very expensive: the GAO has estimated that patenting in nine countries could cost up to $330,000.[77]

2. *Administrative Costs of Tax*

The administrative costs of tax are rather different. These costs are more accurately thought of as compliance costs—expenses for recordkeeping, filling out tax forms, and the like. The best evidence about compliance costs for research tax credits actually comes from surveys of Canadian companies.[78] These surveys asked the companies how much they spent on research, how large a credit they received, and how much they spent on complying with the tax requirements. They found that compliance costs for the Canadian "scientific research and experimental development credit" were low overall but varied quite a lot based on the size of the firm. For instance, estimates of annual compliance costs have ranged between 0.7%[79] and 14.5%[80] of the total

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75. *Id.* at 1502.

76. Chloe Albanesius, *Every Place Samsung and Apple Are Suing Each Other*, PC MAG. (Sept. 14, 2011), http://www.pcmag.com/article2/0,2817,2392920,00.asp.

77. U.S. GEN. ACCOUNTING OFFICE, *supra* note 65, at 40-41.

78. Sally Gunz, Alan Macnaughton & Karen Wensley, *Measuring the Compliance Cost of Tax Expenditures: The Case of Research and Development Incentives*, 43 CAN. TAX J. 2008 (1995); Secretariat to the Review of Fed. Support to Research & Dev. Expert Panel, *Assessing the Scientific Research and Experimental Development Tax Credit*, REV. FED. SUPPORT TO RES. & DEV. (2011), http://rd-review.ca/eic/site/033.nsf/vwapj/4_Assessing_the_SRED_Tax_Credit-eng.pdf/$FILE/4_Assessing_the_SRED_Tax_Credit-eng.pdf [hereinafter Canada SR&ED Study].

79. Gunz et al., *supra* note 78, at 2021.

80. Canada SR&ED Study, *supra* note 78, at 8. The vast difference between these estimates probably reflects the size of the firms being surveyed. The Gunz study had seven responses from companies claiming credits over $10 million, Gunz et al., *supra* note 78, at 2022 tbl.4, whereas the more recent survey's highest range seems to have been $250,000-$500,000. Canada SR&ED Study, *supra* note 78, at 8.

claimed credit. For Canadian taxpayers with the smallest claims (less than $25,000), compliance costs were over one third of the credit amount.[81] This results from fixed costs, such as filling out the requisite paperwork, that the firms had to incur regardless of their claim.[82] There is also, however, a fairly substantial variable component of the compliance costs: some large firms claiming the credit can spend over $100,000 to comply, much of that going to technical documentation of the research activities.[83]

I know of no comparable surveys of American firms' compliance costs for the research tax credit.[84] As a general matter, there is no obvious reason why recordkeeping requirements should be qualitatively different between Canada and the United States. If anything, the costs in the United States may be decreasing, as recent decisions have allowed taxpayers to use a fair estimate of their expenses in claiming the credit, which should ease contemporaneous recordkeeping burdens.[85]

Finally, it is important to take note of costs that are absent from the tax system. Since tax subsidies confer no property rights, there are no enforcement costs of tax.[86] Additionally, there is no international component to the tax system. While it is surely true that foreign countries give credits for research, inventors need not (and typically cannot) claim those credits alongside U.S. federal tax credits.

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81. Canada SR&ED Study, *supra* note 78, at 8.

82. Gunz et al., *supra* note 78, at 2019-20; Canada SR&ED Study, *supra* note 78, at 8.

83. Gunz et al., *supra* note 78, at 2020.

84. Anecdotal evidence suggests that some companies forgo claiming the research tax credit because of compliance costs. *See, e.g.*, U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-10-136, THE RESEARCH TAX CREDIT'S DESIGN AND ADMINISTRATION CAN BE IMPROVED 33-34 (2009) (noting that "[t]he burden of substantiating research credit claims represents a significant discouragement to potential credit users").

85. *See* United States v. McFerrin, 570 F.3d 672, 679 (5th Cir. 2009) (approving the use of reasonable taxpayer estimates for claimed research tax credits); Union Carbide Corp. v. Comm'r, 97 T.C.M. (CCH) 1207, 1268 (2009), *aff'd*, 697 F.3d 104 (2d Cir. 2012) (same).

86. An inventor claiming the research tax credit may incur costs defending an audit or bringing a court case to obtain a refund. While one might argue that these are semantically "enforcement" costs (inasmuch as the government is enforcing the law), they fall under what I have called compliance costs because they are part of the process of receiving the credit. These legal costs are equivalent to the costs incurred during the various stages of review during patent prosecution. *See, e.g.*, Leahy-Smith America Invents Act, Pub. L. No. 112-29, § 7(c), 125 Stat. 284, 314-15 (2011) (to be codified at 35 U.S.C. § 141) (appeal); *id.* § 6(a), 125 Stat. at 299-300 (inter partes review); *id.* § 6(d), 125 Stat. at 305-06 (post-grant review).

3. *Comparing the Administrative Costs of Patent and Tax*

We are now in a position to compare the administrative costs of subsidizing research with the patent and tax systems. Before we actually compare the two systems, though, it is worth briefly pausing to define the scope of the problem. Administrative costs are trivial in some situations. If a pharmaceutical giant is considering whether to begin a billion-dollar research project for a breast cancer drug, the cost of patenting versus the cost of filing a tax return would be drops in the bucket. However, administrative costs are significant when the expected value of the invention is on par with the administrative costs themselves. In other words, the discussion below is mainly confined to smaller-stakes inventions, when an inventor might forgo research because the cost of patent prosecution or tax compliance makes the research not worth it.

Can we make a ballpark comparison of the costs of tax compliance and patent's administrative costs? A first-pass look at the data suggests that, for some innovation environments, it is reasonable to estimate that costs for tax compliance and patent prosecution (not enforcement) are roughly equal. First, using the Canadian data, small- and medium-sized businesses claiming the research tax credit spend approximately 5% of their credit on compliance costs.[87] Second, although there is significant variability across industries, these businesses generate approximately one patent application for every $1.8 million in R&D expenditures.[88] Third, assuming that the entirety of the $1.8 million

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87. Gunz et al., *supra* note 78, at 2024 tbl.6. Small- and medium-sized businesses, in this context, are businesses with up to 1,000 employees. The 5% figure, unfortunately, has several limitations. The Gunz, Macnaughton & Wensley dataset conflates businesses receiving the 35% Canadian refundable credit with businesses receiving the 20% credit, which would deflate the compliance expenditure percentage relative to what it would be for American companies, as American companies only receive a 20% credit. On the other hand, since I am ultimately interested in compliance costs for expenditures on the order of several million dollars, the 5% figure is likely an overestimation, since compliance costs plateau dramatically as research expenditures exceed $1 million. *See id.* at 2022 tbl.4. For that reason, and because firms spending in excess of $1 million on research tend to only spend approximately 2% of their credit on compliance, I think my figure of 5% is a conservatively high estimate. Even if this figure is incorrect by several percentage points either way, it would not affect my qualitative conclusions.

88. *See* Brandon Shackelford, *One in Five U.S. Businesses with R&D Applied for a U.S. Patent in 2008*, NAT'L SCI. FOUND. (Feb. 2013), http://www.nsf.gov/statistics/infbrief/nsf13307/nsf13307.pdf. To arrive at this figure, I first calculated total R&D expenditures for businesses with up to 1,000 employees ($72,183,000,000); I then divided by the total number of patent applications for businesses in that same category (39,680).

qualified for the research credit, that expenditure would yield a compliance cost of $18,000.[89] Patent prosecution costs around $20,000.[90] Thus, the tax compliance and patent prosecution costs of generating a single invention are (very roughly)[91] equal. But this is not the end of the story. The administrative costs of both patent and tax are different in at least three important ways that could make tax the preferable choice for subsidies in particular research environments.

The first difference is that the administrative costs of patent accrue per invention, whereas the costs for subsidizing research with tax credits accrue across inventions. If a researcher is relying on the patent system, she will have to pay filing fees and attorney fees for every invention she wishes to patent. If, instead, she relies on the tax system, her compliance costs will not depend on the number of discoveries she makes. This difference suggests that, in situations where we expect a line of research to generate many discoveries that would need to be independently patented, the tax system may entail lower administrative costs. The consequence of this difference is that the tax system would deter fewer inventors from pursuing socially desirable lines of research.

What industries might exhibit such a pattern? One likely candidate is genetic research. The Federal Circuit has held that inventors may patent isolated genetic sequences.[92] The human genome contains tens of thousands of protein-coding genes.[93] Even more strikingly, the field of synthetic biology—in which inventors create new, artificial sequences—removes any upper limit on patentable sequences.[94] Discovering one of these sequences is becoming increasingly routine as costs have come down.[95] Thus, individual lines of

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89. Because the credit amounts to 20% of the expenditure (in this case, roughly $360,000 of the $1.8 million), and compliance costs are 5% of that credit.

90. *See supra* Subsection II.A.1.

91. This back-of-the-envelope calculation is only meant to show that compliance costs and prosecution costs are on the same order of magnitude.

92. *See In re* Deuel, 51 F.3d 1552, 1560 (Fed. Cir. 1995) (reversing an examiner's denial of a patent for an isolated DNA strand).

93. *About the Human Genome Project*, HUM. GENOME PROJECT, http://web.ornl.gov/sci/techresources/Human_Genome/project/index.shtml (last visited Sept. 16, 2013).

94. *See generally* Sapna Kumar & Arti Rai, *Synthetic Biology: The Intellectual Property Puzzle*, 85 TEX. L. REV. 1745 (2007) (defining synthetic biology and exploring attendant ramifications for intellectual property law).

95. *See DNA Sequencing Costs*, NAT'L HUM. GENOME RES. INST., http://www.genome.gov/sequencingcosts (last updated July 16, 2013) (charting the decreasing cost of sequencing over the years); *see also* Arti K. Rai, *Intellectual Property Rights in Biotechnology: Addressing* genetic research often yield a multitude of inventions. Indeed, in the field of synthetic biology, the number of "parts" (functional proteins coded by man-made genetic sequences) has proliferated in recent years,[96] but many, if not most, of these parts are unpatented, likely because of the high cost of a patent.[97] In such a field, increased tax credits could function as a less distortionary subsidy by avoiding the high costs of patenting many small inventions.

A second difference between tax and patent is that tax subsidies are free from enforcement costs. This has several implications. In industries where use is difficult to detect, patent enforcement will be expensive, which will distort investment decisions. Amy Kapczynski and Talha Syed—in their article about the continuum of patent excludability—offer surgical checklists as an example of an invention that an inventor would have a hard time excluding doctors from using.[98] They argue that such inventions are difficult to appropriate value from. But we can flip this argument on its head: if an inventor of a surgical checklist wanted to exclude competitors, she would need to engage in costly monitoring of the surgical practices in thousands of hospitals nationwide. Moreover, every time the inventor detected a violation, she would need to be able to credibly threaten litigation. These administrative costs might deter an inventor from pursuing a line of research. Thus, enforcement costs will be high in industries with many possible infringers. And if those infringers are not wealthy, the expected value of litigation against them would be low. Enforcement costs will also be higher in industries that are geographically

New Technology, 34 WAKE FOREST L. REV. 827, 834 (1999) (noting that "routine, automated methods" and the low bar for patentability have resulted in biotechnology companies "seeking patents on hundreds of thousands of DNA sequence fragments").

96. For statistics on the total number of "parts" that scientists have made available to each other, see *Statistics Snapshot*, REGISTRY OF STANDARD BIOLOGICAL PARTS, http://partsregistry.org/cgi/partsdb/Statistics.cgi (last visited Sept. 16, 2013). The number of parts in this registry currently totals over 7,000; this number has more than doubled over the last eight years. *See* Kumar & Rai, *supra* note 94, at 1765 (noting that there were more than 2,000 parts available in 2005).

97. Kumar & Rai, *supra* note 94, at 1764-65 ("The more pressing problem for purposes of projects like the MIT Registry—which contains more than two thousand standardized parts—is that a patent-based approach may be quite expensive." (footnote omitted)). It is impossible to know the total number of synthetic biology parts that exist, as some may be kept secret by their inventors. However, scientists have added thousands of unpatented parts to the open source iGEM registry in recent years. *See Statistics Snapshot*, *supra* note 96.

98. Kapczynski & Syed, *supra* note 33, at 1902-03.

dispersed—it is more costly to monitor and maintain a litigation presence nationwide. In such industries, policymakers should consider whether tax incentives might encourage more optimal research decisions.

A third and final difference between tax and patent is that the administrative costs of tax can be reduced more easily than the costs of patent. Why is this important? Because when we come across an industry or group—for instance, small, startup inventors—that might be especially deterred by administrative costs, a common move is to try to selectively reduce those costs. If one system is particularly amenable to this sort of reduction, it might be preferable in those situations where we think administrative costs are stymying research.

There are a few differences between tax and patent that make the administrative costs of patenting more difficult to reduce. The first is that we insist that every patent be examined with the same scrutiny. This is a sensible choice because a patent confers a powerful right to exclude. But this fundamental requirement spawns the significant legal costs of patent prosecution, costs which arguably cannot be reduced.[99] In comparison, not every tax return is audited. This is also sensible. Mistakenly allowing a single taxpayer to claim an improper research tax credit is typically not especially costly.[100] The corollary to this difference is that we could relax the compliance requirements for tax in particular situations where administrative costs are problematic. For instance, if we were concerned that small businesses faced high fixed compliance costs of claiming the research credit, we could reduce documentation requirements if their credit stayed under a certain dollar amount. By comparison, reducing patent prosecution requirements for a small business—for instance, by not requiring them to report prior art—would lead to improper grants of monopoly protection that could cause significant economic harm.[101] Another reason administrative costs are more easily

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99. The tax code does permit a deduction for patent prosecution costs. Treas. Reg. § 1.174-2(a)(1) (2012).

100. The social welfare costs of improperly allowing a tax credit are the distortionary costs associated with collecting taxes to pay that tax credit, where the credit itself is capped at the researcher's own expenditures. *See supra* Section I.C. The social welfare costs of improperly granting a patent depend on the exclusionary and monopoly effects of that patent, *see supra* Section I.B, which are uncapped and much more variable.

101. Congress is aware of the problem that small businesses face when trying to get a patent, and yet the only change passed into law has been a reduction in filing fees. *See* Leahy-Smith America Invents Act, Pub. L. No. 112-29, § 11(d), 125 Stat. 284, 323 (2011) (to be codified at mitigated for tax is that the subsidy itself can be tailored to compensate for the administrative costs. For instance, we might worry that a business filing for the credit for the first time would face burdensome fixed startup costs. If so, we could simply double the allowable credit for that year. Since the tax subsidy and compliance costs are in the same units (dollars), they can easily make up for each other. In contrast, it is not clear how a patent could be made stronger to compensate for high administrative costs. The takeaway from this point is that the administrative costs of tax are much more flexible than the administrative costs of patent, and where administrative costs are distorting research decisions, policymakers should consider whether a reduced-compliance-cost tax regime might be optimal.

Finally, while my focus in this Note is largely on the either/or choice between patent and tax, I should note that there are likely viable hybrid approaches—that is, ways in which the tax and patent systems could be deployed together to compensate for each other's weaknesses. A simple example would be a patent prosecution tax credit. The status quo already allows inventors to deduct the costs of patent prosecution.[102] But the tax code could provide a stronger incentive. For example, we might give a tax credit of up to $20,000 for prosecution costs for any inventor with fewer than three patents. A promising avenue for future work would be to think of creative ways that patent and tax can be coordinated to spur innovation.

B. *Subsidy Timing*

In this Section, I explore how the difference in the timing of the patent and tax subsidy systems affects how they should be deployed. Whereas the subsidies from tax are paid out annually, patent subsidies (in the form of higher profits) can be delayed for many years. This difference has gone largely unnoticed in the academic literature. Several scholars have pointed out that inventions can take decades to commercialize, which might decrease or eliminate the usefulness of the patent system as a means to stimulate

35 U.S.C. § 41(h)). As discussed, this does little to mitigate the most significant costs of patent prosecution. *See supra* notes 71-72 and accompanying text.

102. Treas. Reg. § 1.174-2(a)(1).

research.[103] These scholars have suggested lengthening patent protection[104] or granting new intellectual property rights focused on product development.[105] What these solutions miss—likely because of their single-institution focus on the patent system—is that the payment lag in the patent system is itself quite costly. The tax system avoids this cost by reimbursing the taxpayer immediately.

Delay can undermine a subsidy system. This is so because there are implicit costs in an inventor tying up her own funds in research.[106] Each dollar spent on research is a dollar that the inventor cannot put to other productive uses, such as growing her business.[107] Every year that passes between the initial expenditure and the eventual subsidy, the inventor has to forgo the yield on that expenditure. These delay costs may undermine the efficacy of innovation subsidies: the researcher will only engage in research if current costs are less than the eventual expected value of the research plus the subsidy, discounted by the time delay of the subsidy. The "discount" the researcher assigns to the subsidy will be a function of two things: the length of the delay itself and the annual implicit costs of the delay. I treat each of these concerns in turn, and I conclude that long delays are most harmful to small inventors and to inventions with long time horizons. In such situations, I argue that tax may be a preferable choice.

1. *Subsidy Timing in Patent and Tax*

There are a number of ways to make money from a patent, but most of them require patience. When we think about subsidy timing and patent, it is helpful to divide the process into three phases: first, the inventor conducts the research; second, the inventor applies for a patent; and third, someone develops and commercializes products based on the patent. In the paradigm case, the inventor is the "someone" exploiting the patent. Since the inventor has an exclusive right to sell the invention, she can earn supracompetitive

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103. *See, e.g.*, Michael Abramowicz, *The Danger of Underdeveloped Patent Prospects*, 92 CORNELL L. REV. 1065 (2007); Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341 (2010).

104. *See* Abramowicz, *supra* note 103, at 1108-14 (proposing an auction system for extending patent durations).

105. *See* Sichelman, *supra* note 103, at 402-12 (laying out the details of a proposal for commercialization patents).

106. *See* N. GREGORY MANKIW, PRINCIPLES OF ECONOMICS 261-62 (6th ed. 2012).

107. I explore these costs at greater length *infra* Subsection II.B.2.

profits, which act as the subsidy of the patent system. But this subsidy is delayed in a few ways.

An inventor must first wait through the invention process, and she must spend whatever is necessary to uncover the patentable idea. For research that requires significant upfront investments, this delay can be costly.

Second, the inventor must wait for the PTO to evaluate and issue the patent. The median delay between patent application and patent issuance is three to four years,[108] although now, under the America Invents Act, patent examination can be expedited for a fee of $2,000 for a small entity or $4,000 for a non-small entity.[109]

And third—assuming the patentee is exploiting the patent herself—she must wait until the product is developed and ready to commercialize before realizing any of the patent subsidy. It is difficult to generalize about how long it takes a firm to commercialize a new invention: the delay depends on the field of technology, the size of the firm, and, of course, the invention itself.[110] Nevertheless, it is safe to say that commercializing an invention can take a while. The U.S. patent system encourages patents to be filed early in the product development cycle by setting low patentability requirements and by granting patent rights to the first to file.[111] Indeed, examples abound of famous inventions that were not commercialized for decades, including television (35-year delay between patentable invention and product), radio (15 years), and penicillin (16 years).[112] I'll put to one side the worry—which has been explored by others[113]—that our 20-year patent term might not provide much incentive for inventions with these lag times, and I will assume that the patent system is providing the inventor a subsidy that would induce the research. My focus, rather, is on the costs of the delay itself. It is important to note that these delays are inherent in the patent system: until the inventor puts her invention into

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108. *Average Patent Application Pendency*, PATENTLY-O (Dec. 12, 2011, 6:26 AM), http://www.patentlyo.com/patent/2011/12/average-patent-application-pendency.html.

109. *See USPTO's Prioritized Patent Examination Program FAQs*, USPTO, http://www.uspto.gov /patents/init_events/track1_FAQS.jsp (last updated Aug. 9, 2013, 12:43 PM).

110. For a good discussion of the factors that go into the decision to commercialize, see Office of Tech. Assessment, *Innovation and Commercialization of Emerging Technologies*, U.S. CONG. 49-60 (1995), http://www.fas.org/ota/reports/9539.pdf.

111. *See* Abramowicz, *supra* note 103, at 1079, 1094-95; Sichelman, *supra* note 103, at 372-73.

112. Kitch, *supra* note 32, at 272.

113. *See supra* note 103 and accompanying text.

practice and sells her products, we have no way of knowing how big the subsidy should be. Delay is the price we pay for precision.

Of course, there are other ways to profit from patents, which could potentially make delay a nonissue. The main one is licensing. A patent license is a contract whereby the patent holder agrees to refrain from suing the licensee for infringement. Most licenses are granted in exchange for royalties, plus, oftentimes, a lump-sum payment.[114] Inventors can also assign their patent rights, which grants all of the patentee's rights to the assignee. These contractual relationships are often undertaken when the inventor lacks sufficient complementary assets—such as manufacturing, marketing, and distribution networks—to commercialize the invention.[115]

Royalty payments are subject to the same delay problems as direct commercialization. Selling one's patent rights outright with an assignment might seem to circumvent the delay problem, but the inventor will typically be forced to take a discount if the invention is not likely to yield a profit for quite some time. Indeed, licensing regimes generally are characterized by a less-than-full subsidy for the inventor, who has to share the profits with the licensee or assignee with superior commercializing capabilities.[116] Given a choice, firms opt for commercialization over licensing.[117] Since licensing is generally a second-best approach to earning the patent subsidy, I will not consider it any further.

Timing for the tax system is quite a bit simpler. Since taxes are collected annually, a researcher should not have to wait much more than a year to earn her research tax credit. The tax system can distribute its subsidy so quickly because it is directed at expenditures. When claiming the tax credit, a researcher need not wait to see if her research is marketable. A small wrinkle is that, under the current tax system, the research tax credit is nonrefundable. That means that it is only useful to taxpayers who actually have a tax bill (which the credit reduces). For taxpayers who do not owe taxes, their research

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114. *E.g.*, Mariko Sakakibara, *An Empirical Analysis of Pricing in Patent Licensing Contracts*, 19 INDUS. & CORP. CHANGE 927, 928 (2010).

115. *See* David J. Teece, *Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RES. POL'Y 285, 288-93 (1986).

116. A related reason why licensing is a subpar tool is that the licensor and the licensee have less-than-full knowledge about the value of the patent. Sakakibara, *supra* note 114, at 929-31.

117. *See id.* at 941-42 (noting that larger firms with capabilities prefer to commercialize rather than license so as to extract higher profits).

credit will be, in effect, delayed.[118] Unused credits can be carried forward for up to twenty years.[119]

Thus far, I have argued that patents, as a general matter, subject the researcher to much longer delays than does the tax system. However, policymakers could delve deeper and ask: are there particular industries that are especially prone to long delays between expenditure and subsidy under the patent system? I would suggest focusing on industries where the commercialization process takes the longest. The research phase is variable both in how long it takes and when expenditures are required, even within industries. The patent prosecution phase is fairly consistent across industries. But the time it takes to commercialize inventions can be correlated within an industry. To illustrate, consider the science of materials. Thomas Eagar has lamented that commercializing a new material typically takes about two decades.[120] This is so because it takes some time for manufacturers to understand the benefits of a new material and to effectively integrate it into their products.[121] And many products are governed by manufacturing guidelines that make adopting a new material difficult.[122] These and other factors make commercializing a new material a lengthy process. Industries with long commercialization delays would be good candidates for special tax treatment.

2. *Identifying and Curing High Delay Costs*

Delays are inherent in the patent system and are largely avoided in tax.[123] But, setting aside the length of delay, when will delay be costly? Inventors sustain the largest implicit costs of delay when their research costs comprise a

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118. This has been a subject of criticism, and there have been calls to make the credit refundable. *See* GARY GUENTHER, CONG. RESEARCH SERV., RL31181, RESEARCH TAX CREDIT: CURRENT LAW, LEGISLATION IN THE 112TH CONGRESS, AND POLICY ISSUES 25 (2012), http://usbudgetalert.com/Research%20Tax%20Credit.pdf.

119. I.R.C. § 39 (2012).

120. Thomas W. Eagar, *Bringing New Materials to Market*, 98 TECH. REV. 42, 43 (1995).

121. For an example, see *id.* at 44, which describes the difficulty of using plastics in refrigerators.

122. *See id.* at 47 (describing the outdated requirements that slowed adoption of new fracture-resistant steel in boilers).

123. Hemel and Ouellette note that reward timing is continuous; that is, there is an infinite range of times when we could distribute a subsidy. Hemel & Ouellette, *supra* note 4 (manuscript at 25). For simplicity, in this Subsection I consider only the dichotomous case: immediate versus postponed rewards.

large share of their total assets. I hope this point is intuitive: if a startup firm has access to $1,000,000 of capital, then tying up $800,000 in research for a decade will be catastrophic. The impact of such a delay would be to halt the development of the business itself. Additionally, a company with limited assets risks bankruptcy in the near term by sinking a large chunk of its assets in research. Even if the research is highly promising and—in the sense described in Section I.A—optimal, an inventor might logically shy away from the research if it exposes her to a high risk of insolvency.[124] These two implicit costs—stymied business development and bankruptcy risk—are most substantial when the research costs are on par with the total assets of the inventor. As such, delay will be most costly for lone inventors, small businesses, and startups.

The credit market can ameliorate the problem of high implicit costs of delay. If a startup has in mind a line of research that will likely lead to an extremely profitable invention, a creditor should be willing to finance that project. Of course, money is not free, and creditors will charge the researcher interest on the loan. But the capital-poor inventor should be willing to make modest interest payments, because her capital can be put toward highly productive activities like growing the business and maintaining a liquidity cushion to avoid bankruptcy. As such, access to credit should mitigate the cost of delay by providing the business with cash upfront in exchange for a small fee. However, if the credit market is not functioning "properly," it might charge high interest rates even for safe bets, or it might not provide any additional financing for the research.

There is reason to think that the credit market for financing research is prone to just such failure. Creditors often cannot get perfect information about the commercial prospects of research, which deters them from lending money to the most deserving credit applicants. This information deficit exists for at least two reasons. First, it is difficult to accurately communicate a research plan; often, only the researcher himself truly understands the science and the prospects for success.[125] Second, inventors have an incentive to keep their ideas private until after they get paid, and they may resist full disclosure to a creditor

124. Further complicating matters is the fact that inventors are not purely logical. *See id.* (manuscript at 31-33) (describing how optimism bias and risk aversion may distort research decisions).

125. *See* Richard R. Nelson, *The Economics of Invention: A Survey of the Literature*, 32 J. BUS. 101, 121-26 (1959) (describing the difficulty of top-down planning of research priorities and arguing that the best ideas come from the inventors themselves).

for fear of being scooped.[126] Innovation scholars have understood information asymmetries for decades, but they have typically marshaled this point against the federal government as a direct funder of research in order to justify the patent system.[127] But private-sector creditors are prone to similar mistakes. High-tech startups, for instance, have a difficult time acquiring debt financing.[128] And outsiders are notoriously bad at pricing firms with predominantly intangible assets or high R&D expenditures.[129] Finance scholars have attributed this to information asymmetries: "[M]anagement . . . will often have far better information about the future profitability of undeveloped products and untapped market niches."[130] Thus, we should not rely on the credit markets to ameliorate the costs of delay inherent in the patent system.

This problem is especially severe for lone inventors, small businesses, and startups, which, as I discussed earlier, are disadvantaged most by the costs of delay. These entities are likely to have difficulty securing credit, and thus are least able to cure their high delay costs. Robert Carpenter and Bruce Petersen conducted a survey of 2,400 high-tech firms that went public between 1981 and 1998. They found that after an IPO, small companies tended to have less debt—as a percentage of assets—than large companies.[131] Even more importantly, small companies relied almost entirely on secured debt—debt that is backed by collateral, like buildings.[132] In contrast, large companies relied mostly on unsecured debt.[133] But secured debt does not ameliorate the delay costs of patent, since such debt does not depend on profitable ideas but rather

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126. *Cf.* Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* HAROLD M. GROVES, THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609, 615 (1962) (arguing that marketing information is intrinsically difficult, in part because of the ease with which it may be revealed).

127. *See, e.g.*, *id.* at 615, 623; Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 73 AM. ECON. REV. 691, 695, 703 (1983).

128. *See* Robert E. Carpenter & Bruce C. Petersen, *Capital Market Imperfections, High-Tech Investment, and New Equity Financing*, 112 ECON. J. F54, F64, F68-69 (2002).

129. *See, e.g.*, David Aboody & Baruch Lev, *Information Asymmetry, R&D, and Insider Gains*, 55 J. FIN. 2747, 2749-50 (2000); Louis K.C. Chan, Josef Lakonishok & Theodore Souggiannis, *The Stock Market Valuation of Research and Development Expenditures*, 56 J. FIN. 2431, 2432 (2001).

130. Bradford Cornell & Alan C. Shapiro, *Financing Corporate Growth*, 1 J. APPLIED CORP. FIN. 6, 14 (1988).

131. Carpenter & Petersen, *supra* note 128, at F66-67 & tbl.4 (row 8).

132. *Id.* at F67-68 & tbl.4 (row 9).

133. *Id.* at F68.

on owning mortgageable property. Equity is also of little help: selling a portion of one's future profits diminishes the incentive to capitalize on the patent.[134] These data paint a bleak picture for small firms relying on patents: they face high implicit costs from sinking money into research and they are unable to sustain themselves with credit.

The previous discussion might be clarified by a quick illustration. Imagine a small business with an idea for a new photon torpedo. The business could pay for the research itself, but it would have to reduce its production of ray guns, which it could only do for a short period before going out of business. Instead, it goes to the bank for a loan. The bank is clueless about photon torpedoes, so it insists that the company mortgage its warehouse. But the company protests: mortgaging the warehouse was the backup plan in case the market weakened and bankruptcy threatened. If patent is the only option, the company abandons the research: it can't afford the capital in the near term even if it thinks it could make money once it has commercialized the photon torpedo. But what about applying for a tax credit?

Policymakers could use the tax system to selectively bolster the domains of research where the patent system falters because of delay costs. For instance, tax credits could be targeted at the small businesses and lone inventors most likely to find the delay of the patent system unpalatable. In the previous example, the company might have researched the photon torpedoes if it could have been reimbursed with tax credits quickly. In order to target the credit at companies who truly need it, policymakers could increase the percentage of research expenditures reimbursed for companies with no more than a certain number of employees or amount of gross income. To minimize the distortionary effects of taxation, this small business R&D bump could be capped at a particular reimbursement amount to ensure that only the company's top-priority research projects would be funded at this favorable rate. But the tax system is extremely flexible, and we could perhaps be even more creative. For example, if we were primarily concerned with startup companies' access to capital, we might consider a very large credit for the first three years of the startup's existence, which the startup would have to pay off through later rate hikes. If the problem is that startups lack access to credit, why not provide them with precisely that?

This could also be an opportunity to deploy a hybrid patent-tax approach. As we have seen, one of the longest delays in the patent system is that associated with commercialization. This delay cost could be alleviated with the

134. *See* Hemel & Ouellette, *supra* note 4 (manuscript at 26).

tax system. The IRS already treats a patent as conclusive evidence that a line of research is technological in nature.[135] This eases the burden on the inventor claiming the tax credit, but it does little to alleviate the costs of delay. Instead, we could provide a larger tax credit to inventors receiving a patent. This credit could apply retroactively to research that led to the discovery. The goal of this credit would be to target those inventors most likely to be experiencing delay costs in the near term. To even better effectuate this goal, we could impose a "commercialization" requirement: receiving the additional tax benefit could be contingent on producing evidence of a good faith effort to commercialize the product. Such a credit would be most beneficial to small entities, and could be so directed as described in the previous paragraph.

More favorable tax treatment could also be accorded to entities engaged in research in fields with long commercialization periods. Of course, this sort of "winner picking" is a dangerous game: the tax and patent systems are agnostic about subject matter precisely because we think the government is bad at choosing which research is worthy of help. That said, the tax system is littered with subsidies for favored types of research.[136] In contrast to such existing subsidies—which are arguably not based on economic logic but on policy preferences—choosing to give favorable treatment to, for example, materials science research would be based on an identifiable market failure.

C. Rewarding Failure

The previous Section explored when the tax and patent systems distribute their subsidies. But there are also salient differences in what sorts of research these regimes subsidize. As a general rule, the tax subsidy is broader than the patent subsidy. If we can identify situations where the scope of the patent subsidy is inefficiently narrow, the tax system may be a good candidate to fill that gap. In this Section, I argue that one such area where tax could be valuable is in correcting patent's inability to subsidize "valuable failure."

I have already explained the difference between the patent and tax subsidy regimes.[137] As relevant for our purposes here, patents are only awarded for new inventions, and the patent subsidy is only available through commercialization.

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135. *See supra* note 55 and accompanying text.

136. *See, e.g.*, I.R.C. § 41(a)(3) (2012) (energy research tax credit); *id.* § 45C (tax credit for research on orphan drugs, which are designed to treat rare diseases).

137. *See supra* note 55-59 and accompanying text.

Tax has no such requirement. The success or failure of a course of research does not affect the research's qualification for the tax credit.

This difference will affect the decision to research. All else equal, the patent system should bias researchers to undertake projects with higher likelihoods of success and commercial applicability. Indeed, this is an intended effect of patent, as the traditional model of innovation assumes that research enhances social welfare by producing socially useful innovations.[138] On the other hand, commentators have criticized the tax system's lack of selectivity for success as failing to properly align research incentives with social welfare.[139] They have recommend moving to a prize-like system where the credit is only available for successful discoveries[140] or for projects approved by the government.[141] I don't disagree with these critiques, but I also think they paint an incomplete picture.

An oft-overlooked issue is the social welfare benefit of failed research. Sean Seymore's recent article on the topic summarizes the concept nicely: "Failure is the basis of much scientific progress because it plays a key role in building knowledge."[142] A failed experiment always produces some data, if only that a particular technique is ineffective. But failure can be even more valuable as a way of exploring uncharted territory and constructing a knowledge base. Consider a few examples where researchers have found their own failures to be valuable.[143] In her book on innovation, Dorothy Leonard-Barton recounts an incident concerning the development of a new metal alloy at Johnson & Johnson.[144] To encourage experimentation, the vice president of operations *required* his chief metallurgist to discard two out of every three test batches of

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138. *E.g.*, William F. Baxter, *Legal Restrictions on Exploitation of the Patent Monopoly: An Economic Analysis*, 76 YALE L.J. 267, 274 (1966) ("The principal determinant of the social value of an invention is the extent to which it is useful and used."); Shavell & van Ypersele, *supra* note 4, at 531-34 (posing a model where social welfare is contingent on the "probability of an innovation").

139. *E.g.*, GUENTHER, *supra* note 118, at 30-31; Michael D. Rashkin, *The Dysfunctional Research Credit Hampers Innovation*, 131 TAX NOTES 1057 (2011).

140. Johnson, *supra* note 2, at 612.

141. Rashkin, *supra* note 139.

142. Sean B. Seymore, *The Null Patent*, 53 WM. & MARY L. REV. 2041, 2041 (2012).

143. To be clear, these examples concern failures that are valuable primarily to the researchers themselves. As discussed below, the important shortcoming of the patent system occurs where the failures also are valuable to the rest of society. *See infra* note 154 and accompanying text.

144. DOROTHY LEONARD-BARTON, WELLSPRINGS OF KNOWLEDGE: BUILDING AND SUSTAINING THE SOURCES OF INNOVATION 122-23 (1995).

metal.[145] The metallurgist went on to discover the alloy within a year, presumably because he was free to experiment with more risky mixtures. Failures are often literally stockpiled: pharmaceutical companies typically keep "chemical libraries" of the chemical compounds they synthesize, which can be screened for possible future treatments.[146]

In innovation environments where failures are valuable, and where these failures are communicated beyond the researcher herself, the patent system will systematically fail to subsidize some research that is socially beneficial. Patent law only operates on successful innovations. Even if patent law is maximally effective—in that the social value of the patented inventions is wholly appropriable by the inventor—it will fail to calibrate research decisions to the value generated by failed experiments. Any regime that rewards researchers solely based on their successful discoveries will be subject to this critique. The research tax credit is not such a regime. If we could know the expected social value of research failure, we could increase the credit to correct for this inefficiency. Of course, this would be a difficult value to ascertain. But the research tax credit, unlike the patent regime, at least provides a lever that is capable of capturing value from failed experiments, however roughly. The concern with implementing a credit of this sort—as with all tax credits—is that the subsidy would be too large and would encourage research with total costs higher than total expected social value. Thus, we should try to tailor the credit narrowly to compensate for situations where the patent system has failed most egregiously. This will occur when failure is the most socially valuable.

One area where failure will often be quite valuable is in emerging industries. The canonical illustration is perhaps the invention of the incandescent light bulb, which required Thomas Edison and his associates to conduct over one thousand tests before finding a material that could serve as the bulb's filament.[147] More relevant for our purposes is that inventors for decades before Edison had tried to make a commercially viable incandescent light bulb but failed, which produced insights—such as the necessity of a

145. *Id.* at 122.

146. STEFAN H. THOMKE, EXPERIMENTATION MATTERS: UNLOCKING THE POTENTIAL OF NEW TECHNOLOGIES FOR INNOVATION 24 (2003).

147. *Thomas Alva Edison (1847-1931): Electric Light Bulb*, MASS. INST. TECH., http://web.mit.edu/invent/iow/edison.html (last visited Oct. 22, 2013).

vacuum tube enclosure—that Edison's team would build upon.[148] The lesson of this anecdote has found support in systematic research. James Utterback describes three phases of an industry's innovative progress: fluid, transitional, and specific.[149] The fluid phase is characterized by significant "target" and "technical" uncertainty. According to Utterback, the hallmark of target uncertainty is "the fact that most early innovations do not enjoy an established market," while technical uncertainty is caused by "the diffused focus of research and development."[150] During the fluid phase, firms "have no clear idea where to place their R&D bets" and they will often "concentrate on product technologies that ultimately will be ignored by the marketplace."[151] In other words, quite a lot of the early research in an emerging industry fails. A related line of scholarship concerns the pursuit of radical versus incremental innovation; unsurprisingly, radical innovation is more characterized by experimentation and failure.[152] As an industry matures, the preferences of consumers become known, standards are established, and the knowledge base grows. This transition is associated with research becoming more focused and innovations more incremental.[153]

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148. *Incandescent Lamps*, EDISON TECH CENTER, http://www.edisontechcenter.org/incandescent.html (last visited Nov. 6, 2013) (discussing the discoveries that gave rise to the incandescent light bulb, including the evolution of vacuum tubes).

149. The clearest description of these phases is at JAMES M. UTTERBACK, MASTERING THE DYNAMICS OF INNOVATION: HOW COMPANIES CAN SEIZE OPPORTUNITIES IN THE FACE OF TECHNOLOGICAL CHANGE 92-97 (1994). Earlier research first describing these concepts—although using different terminology—can be found in James M. Utterback & William J. Abernathy, *A Dynamic Model of Process and Product Innovation*, 3 OMEGA INT'L J. MGMT. SCI. 639 (1975).

150. UTTERBACK, *supra* note 149, at 93.

151. *Id.*

152. *See, e.g.*, Álvaro López Cabrales et al., *Managing Functional Diversity, Risk Taking and Incentives for Teams To Achieve Radical Innovations*, 38 R&D MGMT. 35, 45 (2008) (finding that radical innovations were more likely where researchers were encouraged to take risks, such that "success may be less likely"); Robert D. Dewar & Jane E. Dutton, *The Adoption of Radical and Incremental Innovations: An Empirical Analysis*, 32 MGMT. SCI. 1422, 1430 (1986) (finding a correlation between firm size and adoption of radical innovations in the footwear industry, and hypothesizing that this finding was due to large firms giving researchers "more slack to permit failures" and allowing "more risk-taking"). For a good description of radical innovation, see Christine S. Koberg, Dawn R. Detienne & Kurt A. Heppard, *An Empirical Test of Environmental, Organizational, and Process Factors Affecting Incremental and Radical Innovation*, 14 J. HIGH TECH. MGMT. RES. 21, 23 (2003), which describes it as "making obsolete the old" and "serv[ing] to create new industries, products, or markets."

153. Utterback & Abernathy, *supra* note 149, at 644.

The above discussion gives rise to the following recommendation: emerging industries would be good candidates for a boosted research tax credit. While this proposition may be uncontroversial, I believe the logic is novel: the patent system does not sufficiently compensate this research because such research often produces valuable failures. These failures are "valuable" inasmuch as they map out uncharted territories and produce intermediate discoveries that are not themselves commercially viable. We could use tax credits to selectively boost these fields while they are in the fluid stage.

A reasonable objection to this proposal is that most failures are not *socially* valuable because they are not publicized. To the extent that a researcher's failures only help herself, they are mere research costs, which should be properly calibrated by the patent system.[154] However, there are several reasons to think that some failures are disseminated and thus are valuable not just to the researcher but to society at large.

The classic failed experiment in basic research is one that produces no effect and thus does not give rise to any patentable invention. While it is certainly true that academia disfavors failed experiments, especially in top-tier journals like *Nature* and *Science*, many run-of-the-mill journals accept well-conducted studies yielding negative results.[155] Several journals are specifically dedicated to publishing such experiments.[156] And, in at least some academic disciplines, it is common to share data of all sorts amongst one's peers.[157]

Failed research initiatives may tend to remain more secretive in commercial settings, where there is more pressure to protect ideas and data. Nevertheless, there is reason to believe that some failure data leak out. First, a line of research

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154. For example, to the extent that a pharmaceutical company's chemical library is a useful tool in promoting that company's future discoveries, the company—operating in a patent-only system—would value failures inasmuch as they contributed to its library. However, to the extent that the company's competitors could access the company's chemical library and use the library to produce their own valuable discoveries, the company would not take into account the full social value of its failures.

155. A quick glance through a recent issue of the *Journal of Vision* is illustrative. *E.g.*, Allison M. McKendrick & Josephine Battista, *Perceptual Learning of Contour Integration Is Not Compromised in the Elderly*, J. VISION, Jan. 4, 2013, at 1.

156. *E.g.*, ALL RESULTS JOURNALS, http://www.arjournals.com/ojs (last visited Sept. 16, 2013).

157. I can speak from personal experience about the discipline of neuroscience, which has an annual convention where tens of thousands of researchers converge to present whatever project they worked on over the previous year. SOC'Y FOR NEUROSCIENCE, http://www.sfn.org/annual-meeting/neuroscience-2013 (last visited Sept. 16, 2013). These experiments are frequently unfinished or negative: the annual meeting is an opportunity to exchange ideas about how to move these projects forward.

may "fail" and still produce a marketable product. This is the case because—for our purposes—"failure" simply means that the line of research is not receiving much or any patent subsidy. A simple example is the video game industry in the 1970s and '80s: dozens of innovative hardware systems competed for market share and influenced future design choices, but many of them were flops. Some of these failures were cautionary tales to future game designers;[158] others provided important insights that paved the way for eventual success.[159] These failed designs produced social value that went largely uncompensated by the patent system by dint of lack of sales but they were nonetheless shared publicly.

There is also reason to believe that data about failure leak out even absent any commercialization. In one classic study by Levin and colleagues, the researchers conducted a wide-ranging survey of high-level executives in various R&D-heavy industries.[160] While not the focus of their study, many of their inquiries focused on the ways in which these industry insiders acquired knowledge about their competitors' innovations. Unsurprisingly, patent disclosures and publications rated as moderately useful for most industries.[161] Importantly for our purposes, however, there were a substantial number of industries where "conversations with employees of [the] innovating firm" and "hiring R&D employees from [the] innovating firm" were reported to be important ways of learning about competitors' technologies.[162] I would submit

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158. To give just one example, the Vectrex bucked industry norms by using vector graphics instead of the raster display typical of home consoles at the time. The Vectrex was a market failure, though, and vector graphics have been abandoned in modern gaming systems. *See* Mark J.P. Wolf, *Vector Games*, *in* THE VIDEO GAME EXPLOSION: A HISTORY FROM PONG TO PLAYSTATION® AND BEYOND 67, 71 (Mark J.P. Wolf ed., 2008); Matt Barton & Bill Loguidice, *A History of Gaming Platforms: The Vectrex*, GAMASUTRA (Dec. 17, 2007), http://www.gamasutra.com/view/feature/3117/a_history_of_gaming_platforms_the_.php.

159. An example is the Shooting Gallery, released for the Magnavox Odyssey in 1972. This video game peripheral was the first light gun usable on a home video game system. The Shooting Gallery did not sell well. *See* Shaun Gegan et al., *Magnavox Odyssey FAQ*, PONG-STORY, http://www.pong-story.com/o1faq.txt (last updated Nov. 27, 2009). Nevertheless, it arguably set the stage for the development of the immensely popular Zapper for the Nintendo Entertainment System thirteen years later. Sammy Barker, *A Brief History of the Light Gun on Nintendo*, NINTENDO LIFE (Nov. 2, 2007, 8:20 AM), http://www.nintendolife.com/news/2007/11/a_brief_history_of_the_light_gun_on_nintendo.

160. Levin et al., *supra* note 17, at 788-90.

161. *Id.* at 806 tbl.6.

162. *Id.*; *see also* Eric von Hippel, *Cooperation Between Rivals: Informal Know-How Trading*, 16 RES. POL'Y 291, 291-92, 297-300 (1987) (describing the informal exchange of knowledge between competitors and providing an economic justification for such behavior). Professor that these informal channels of communication must consist of information about failures, as I define them. An R&D executive can learn about a successful line of research by reading a patent or reverse engineering a product. Informal modes of communication are only valuable if they yield information about lines of research that don't otherwise become public. The Levin study further found that there were clusters of industries where such "interpersonal channels of spillover were most important."[163] Examples abound of industries where competitors cooperate through both formal and informal networks to overcome common research problems.[164] Tax incentives aimed at promoting socially valuable failure would be most useful in those industries where ideas are more freely exchanged.

Finally, we should consider measures that would be designed to promote the dissemination of valuable failure information. Professor Seymore has put forward one such idea, which he calls the "null patent."[165] This would provide inventors with centrally distributed incentives for disclosing their failed projects. Another possibility would be to tie disclosure to the receipt of the tax

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von Hippel has further elaborated on this model to account for the rise of open source software and other "free reveal" behavior by users. Dietmar Harhoff, Joachim Henkel & Eric von Hippel, *Profiting from Voluntary Information Spillovers: How Users Benefit by Freely Revealing Their Innovations*, 32 RES. POL'Y 1753, 1759-67 (2003).

163. Levin et al., *supra* note 17, at 807; *see also* Reinhilde Veugelers, *Collaboration in R&D: An Assessment of Theoretical and Empirical Findings*, 146 DE ECONOMIST 419, 436 tbl.3 (1998) (reporting similar data for Flemish companies); Najib Harabi, *Channels of R&D Spillovers: An Empirical Investigation* (MPRA Paper No. 26270, 1995) (obtaining similar results from a survey of Swiss companies and reporting inter-industry differences in the importance of informal disclosure channels).

164. The classic illustration of cooperation amongst competitors is Silicon Valley: "By the early 1970s Silicon Valley was distinguished by the speed with which technical skill and know-how diffused within a localized industrial community. . . . Individuals moved between firms and projects without the alienation that might be expected with such a high degree of mobility . . . ." ANNALEE SAXENIAN, REGIONAL ADVANTAGE: CULTURE AND COMPETITION IN SILICON VALLEY AND ROUTE 128, at 37 (1996). To offer a more specific example, consider SEMATECH. This research consortium was founded by a group of domestic manufacturers that produced the vast majority of semiconductors. *See* Larry D. Browning, Janice M. Beyer & Judy C. Shetler, *Building Cooperation in a Competitive Industry: SEMATECH and the Semiconductor Industry*, 38 ACAD. MGMT. J. 113, 115 (1995). Participant firms assign researchers to work in SEMATECH laboratories for several years to overcome basic design problems that face the entire industry. *Id.* at 116. Finally, for an in-depth investigation of information trading in the steel industry, see von Hippel, *supra* note 162, at 292-96. *See also* Harhoff et al., *supra* note 162, at 1757-59 (describing several examples of strategic innovation disclosures by users to influence the production processes of manufacturers).

165. Seymore, *supra* note 142, at 2048.

benefits themselves. This idea would need to overcome two significant limitations. First, such a system would be expensive for both the monitoring agency and the complying firm. Second, firms might be reluctant to accept tax funds if they had to forfeit the benefits of lead time and secrecy. We can envision some possible solutions, however. To lower the costs for the government, reporting could be monitored by random audit. To lower costs for firms, the reporting itself could consist of mere notice of the research. Curious competitors could be responsible for shouldering additional costs of transmitting data. To allay concerns about competitive advantage, the reporting could be delayed—after all, firms may not be sure what is a success or failure for quite some time. The system could give firms a several-year grace period before they would be required to report their failed experiments. These suggestions, of course, are mere rough sketches—much more work is required to explore how the research community can overcome the problem of underreporting valuable failures.

D. Institutional Competence

In this final Section, I will consider the relative strengths and weaknesses of the actual institutions that implement patent and tax. By "institutions," I am referring collectively to the policymakers, agencies, adjudicators, and other individuals that are responsible for legislating and executing the tax and patent laws. I will argue that there are substantial differences between the institutions that oversee and implement patent and tax law. In particular, the institution governing tax law is more flexible and more capable of quickly responding to policy concerns than the institution that implements patent law, although these qualities make tax a more difficult regime for researchers to rely on. These differences recommend using tax in situations where policymakers may wish to adjust subsidy rules in response to changing circumstances, such as emerging industries.

1. Comparing Institutional Competences of Tax and Patent

The patent laws are, of course, passed by Congress. Congress doesn't tinker with them very often,[166] and when it does, as with the recent America

166. Clarisa Long, *The PTO and the Market for Influence in Patent Law*, 157 U. PA. L. REV. 1965, 1968 (2009) ("Since 1952, Congress has not taken much interest in amending the patent code . . . .").

Invents Act,[167] the changes are typically procedural.[168] Congress's occasional tweaks of substantive patent law are usually unsuccessful. An illustrative example is the special protection afforded to semiconductor chips.[169] This law provides manufacturers of semiconductor chips with the right to prevent others from producing chips with identical layouts.[170] But the evolution of the semiconductor industry made this right irrelevant: small-time copyists cannot afford the expensive equipment required to manufacture modern chips.[171] Thus, practically no litigation has been brought to enforce the statutory right.[172] This illustrates a fundamental problem with congressional control of innovation policy: Congress is typically either unwilling or incapable of modifying the details of patent law in response to policy concerns.[173]

In most areas of law, Congress would delegate these complicated and controversial implementation details to an executive agency. The main executive agency responsible for implementing patent law is the PTO. Clarisa Long has described recent moves by the PTO to enhance its power. These include an aggressive campaign for more deference,[174] a reorganization of the PTO that gave the agency more control over budget allocations,[175] and a push by the PTO to get greater rulemaking authority.[176] Notwithstanding these power grabs, the PTO is a comparatively weak agency. Critically, the Federal Circuit has held that the PTO does not have substantive rulemaking

167. Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (to be codified in scattered sections of 35 U.S.C.).

168. The most significant changes in the America Invents Act include a change to a "first-to-file" system, *id.* § 3, 125 Stat. at 285-87, and the establishment of post-grant opposition proceedings, *id.* § 6(a), 125 Stat. at 300.

169. 17 U.S.C. §§ 901-914 (2012).

170. *Id.* § 905.

171. *See* Dan Callaway, *Patent Incentives in the Semiconductor Industry*, 4 HASTINGS BUS. L.J. 135, 138-40 (2008).

172. *Id.*

173. Professor Long guesses that Congress may be reluctant to modify patent laws because it sees those laws as too "complex and technical." Long, *supra* note 166, at 1969.

174. *Id.* at 1977; *see also* Dickinson v. Zurko, 527 U.S. 150, 152-53 (1999) (vindicating the PTO's position that its factual determinations should be reviewed by the Federal Circuit under the more deferential standards of the APA rather than the less deferential clearly erroneous standard).

175. Long, *supra* note 166, at 1973-74.

176. *Id.* at 1979.

authority.[177] A consequence of this holding is that courts do not defer to the PTO on substantive interpretations of the patent statutes.[178] Without the power to make rules or to make substantive interpretations of the patent laws, it is not clear that the PTO is in a position to effect any significant changes to innovation policy.

With Congress uninterested and the PTO powerless, the task of patent policymaking has fallen to the courts, particularly the Federal Circuit. The Federal Circuit is a twelve-seat court with subject-matter jurisdiction over all appeals related to patents.[179] Largely unchecked by the Supreme Court,[180] the Federal Circuit is typically the last and loudest voice on all matters patent. Indeed, Ryan Vacca argues that the Federal Circuit's en banc hearings are basically equivalent to agency rulemaking proceedings.[181] But the Federal Circuit is a limited rulemaker for a number of reasons. First, Federal Circuit policymaking takes a long time. As we have seen, acquiring a patent takes years.[182] Add to that delay the time it takes to bring a lawsuit, to litigate the case through trial and appeal, and for the Federal Circuit to issue a decision. To take just one example, in *Marine Polymer Technologies, Inc. v. HemCon, Inc.*, an en banc decision issued in March 2012, the Federal Circuit affirmed a finding of patent infringement.[183] The patent application was filed on July 11, 2003,[184] and the litigation began in March 2006.[185] Any policy coming out of the Federal Circuit will come slowly.[186]

Even when the Federal Circuit makes decisions, there is no guarantee its decisions will further laudable innovation policy. Federal Circuit judges do not

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177. Tafas v. Doll, 559 F.3d 1345, 1352-53 (Fed. Cir. 2009).

178. *Id.*; Long, *supra* note 166, at 1980-82.

179. *See* 28 U.S.C. § 1295 (2006).

180. *See* Rebecca S. Eisenberg, *The Supreme Court and the Federal Circuit: Visitation and Custody of Patent Law*, 106 MICH. L. REV. FIRST IMPRESSIONS 28 (2007).

181. Ryan Vacca, *Acting like an Administrative Agency: The Federal Circuit En Banc*, 76 MO. L. REV. 733 (2011).

182. *See supra* Section II.B.

183. 672 F.3d 1350 (2012) (en banc).

184. U.S. Patent No. 6,864,245 (filed July 11, 2003).

185. *HemCon*, 672 F.3d at 1355.

186. Arti Rai recently noted the problem of delay associated with ex post decisionmaking and advocated for giving the PTO more rulemaking authority. Arti K. Rai, *Patent Validity Across the Executive Branch: Ex Ante Foundations for Policy Development*, 61 DUKE L.J. 1237, 1242 (2012).

necessarily have the know-how or the raw data to make informed, innovation-optimizing decisions. Senior Judge Plager has expressed frustration with the court's inability to discern whether a particular law is sound policy: "How are the judges to make this assessment? Read newspaper and law review articles? Hold public hearings? . . . Shall the [Federal Circuit's] rules now include a requirement that the appellant specify in what manner Congress got its policy wrong . . . ?"[187] Another problem is that many judges on the Federal Circuit may be simply unwilling to set policy. Judge Plager, for example, objects strongly to the notion that the Federal Circuit should "see to it that the consequences of the policies and decisions of [Congress and the Supreme Court] properly reflect current needs and market conditions."[188] Indeed, most appellate judges may see their job as merely "[a]pplying the law"[189] to "decide cases."[190]

Despite—or perhaps because of—the Federal Circuit's limitations as a policymaker, that court has frequently clashed with the executive branch over patent policy. For example, until recently the Federal Circuit had been stymying the executive branch's efforts to tighten the patentability of isolated gene sequences. The DOJ opposes patentability of these sequences.[191] While the DOJ has not explained its policy motivations, the ACLU—representing the party opposed to patentability—has.[192] The ACLU argued that patents on isolated DNA would frustrate future research.[193] Various amici focused almost exclusively on this point, warning of a "patent thicket that can inhibit future innovation."[194] But the Federal Circuit roundly rejected the DOJ's position.[195]

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187. S. Jay Plager & Lynne E. Pettigrew, *Rethinking Patent Law's Uniformity Principle: A Response to Nard and Duffy*, 101 NW. U. L. REV. 1735, 1742 (2007).

188. *Id.* at 1743.

189. *Id.* at 1742.

190. *Id.* at 1743 (quoting Chief Justice John G. Roberts, Jr.).

191. Brief for the United States as Amicus Curiae in Support of Neither Party, Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office, No. 2010-1406 (Fed. Cir. Oct. 29, 2010), 2010 WL 4853320.

192. *E.g.*, Brief for Petitioners, Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107 (2013) (No. 12-398), 2013 WL 353961.

193. *Id.* at *24-25.

194. *E.g.*, Brief of Genformatic LLC as Amicus Curiae in Support of Petitioners, *Myriad Genetics, Inc.*, 133 S. Ct. 2107 (No. 12-398), 2013 WL 417735, at *5; *accord* Brief of Amici Curiae, Information Society Project at Yale Law School Scholars in Support of the Petition, Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 132 S. Ct. 1794 (2012) (No. 11-725), 2012 WL 166995.

The Supreme Court eventually stepped in, siding with the government and disallowing the patent on the isolated DNA.[196] But even the Court did not explicitly consider the policy implications of patenting isolated DNA.[197]

The contours of tax policymaking are markedly different. Congress amends the research tax credit practically every year.[198] These amendments are often substantive: examples range from changing the credit formula to correct unintentional disincentives[199] to adding perks for preferred researchers[200] and research areas.[201]

Courts play a more minor role for tax than for patent. To be sure, many of the critiques regarding the capacity and willingness of courts to make good patent policy apply with equal force to tax. Nevertheless, we need not dwell long on the role of the judiciary, because it occupies a much weaker position vis-à-vis the other branches. The Court has recently held that the Treasury Department is entitled to *Chevron* deference with respect to certain interpretive regulations, which diminishes the responsibility of courts while strengthening the agency.[202] Additionally, standing doctrine usually denies third parties the opportunity to challenge tax assessments.[203] As a consequence, courts will rarely have any opportunity to review decisions by the Treasury Department to let a taxpayer take a beneficial deduction or credit. If Treasury refuses to challenge an inventor making a bold interpretation in claiming the research tax credit, that interpretation is de facto law.

For these reasons, the Treasury Department exerts significant control over tax policy, especially in the administration of tax credits. As such, it is useful to contrast Treasury and the Federal Circuit as policymakers.[204] As I discussed

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195. Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office, 689 F.3d 1303 (Fed. Cir. 2012), *aff'd in part, rev'd in part sub nom.* Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107 (2013).

196. *Myriad Genetics, Inc.*, 133 S. Ct. 2107.

197. *See id.* at 2117-18.

198. *See* GUENTHER, *supra* note 118, at 11-15.

199. *Id.* at 13 (describing changes made to the fixed-base percentage in 1989).

200. *Id.* at 13-14 (describing amendments to help start-up businesses).

201. *Id.* at 14 (describing the addition of the tax credit for energy research).

202. Mayo Found. for Educ. & Research v. United States, 131 S. Ct. 704 (2011).

203. *See* Ariz. Christian Sch. Tuition Org. v. Winn, 131 S. Ct. 1436, 1442 (2011).

204. I don't mean to discount Congress as an important player in tax: all of the advantages of the Treasury Department apply to Congress as well when Congress is enacting tax policy. I focus on Treasury simply because it is more active.

earlier, the three main deficits of the Federal Circuit are that it can only make ex post decisions, it lacks expertise, and it does not prioritize making sound economic policy. The Treasury Department differs in all three respects.

Perhaps the most important difference between the PTO and the Treasury Department is that Treasury can issue ex ante guidance. This includes private letter rulings, technical advice, revenue rulings, and Treasury regulations.[205] Some of these are largely informative; private letter rulings, for example, apply the law to one taxpayer's facts.[206] Others are more legislative in character. Treasury regulations, which the agency typically puts through the notice-and-comment process,[207] can be quite substantive. For our purposes, two types of substantive regulations are particularly important. First, the Treasury Department can declare that it will not challenge claimed tax credits that meet some lowered threshold. For example, as I described earlier, Treasury has recognized a patent safe harbor, whereby obtaining a patent is conclusive evidence of several of the requirements for claiming the credit.[208] Second, Congress can allow Treasury to propound rules of conduct. For example, Congress explicitly invited Treasury's help regarding internal-use software, which does not qualify for the research tax credit "[e]xcept to the extent provided in regulations."[209] Treasury issued regulations laying out a three-part test for qualifying internal-use software,[210] which the agency has subsequently clarified in the face of public criticism.[211] These forms of ex ante guidance are especially suitable for rapidly changing technological landscapes, a point I will return to in the next Subsection.

The Treasury Department also differs from the Federal Circuit in that it has the expertise to set policy. An important tool at Treasury's disposal is the ability to solicit public feedback via notice-and-comment rulemaking. And the

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205. John F. Coverdale, Chevron*'s Reduced Domain: Judicial Review of Treasury Regulations and Revenue Rulings After* Mead, 55 ADMIN. L. REV. 39, 64-65 (2003).

206. *Id.* at 64 n.148.

207. *Id.* at 67.

208. Treas. Reg. § 1.41-4(a)(3)(iii) (2012).

209. I.R.C. § 41(d)(4)(E) (2012). The Treasury Department does not limit its substantive regulations to instances where they are explicitly called for. *E.g.*, Qualified Research for Expenditures Paid or Incurred in Taxable Years Ending on or After December 31, 2003, 26 C.F.R. § 1.41-4 (2012) (articulating legal tests to clarify when research is sufficiently innovative to qualify for the research tax credit).

210. Credit for Increasing Research Activities, 66 Fed. Reg. 280, 292-93 (Jan. 3, 2001); *see also id.* at 285-87 (explaining the changes).

211. Credit for Increasing Research Activities, 66 Fed. Reg. 66,362, 66,371 (Dec. 26, 2001).

Treasury Department—which houses departments including the Office of Tax Analysis and the Office of Economic Policy—is well situated to evaluate the economic effects of innovation policy. Of course, we should not overestimate Treasury's expertise. Tax lawyer Michael Rashkin has criticized Treasury's capacity to administer the credit.[212] He argues that the National Science Foundation would be a better agency to allocate the subsidy.[213] I don't disagree with Rashkin—the Treasury Department may lack the technical expertise that would be necessary to best implement the tax credit. However, compared to the Federal Circuit, the Treasury Department is the clearly superior policymaker. Treasury can hire expert staff, consult other agencies, and solicit public comments. None of my policy recommendations actually turn on Treasury itself having the final word; rather, they all turn on choosing the institution of tax—however implemented—over that of patent.

Finally, the Treasury Department, unlike the Federal Circuit, is a willing policymaker, especially when asked. I don't think this point needs much elaboration. As discussed above, Treasury is quite capable of passing regulations to implement statutes. In passing those regulations, Treasury explicitly considers policy implications. To take just one example, Treasury decided to extend the credit to internal-use software that is developed in conjunction with hardware once it realized how prevalent such hardware-software combinations were.[214]

In sum, Treasury is an active, knowledgeable participant in setting tax policy, and it is able to issue ex ante substantive rules to guide conduct.

2. *Policy Implications*

The institutional differences between patent and tax make tax a particularly useful innovation subsidy for encouraging emerging industries.

As discussed in the previous Subsection, tax policymakers (Treasury, and to a lesser degree, Congress) are capable of responding to oversights and inefficiencies quickly, without the delay inherent in the patenting-litigation process. With this nimbleness, Congress in turn should feel comfortable passing less definite statutes and delegating interpretive responsibilities to Treasury. To use a concrete example, consider my suggestion from Section II.A

212. RASHKIN, *supra* note 39, ¶ 915.03.

213. Rashkin, *supra* note 139, app. I.

214. Credit for Increasing Research Activities, 66 Fed. Reg. at 66,365.

that Congress might want to target subsidies at research designed to uncover new synthetic genetic sequences.[215] Congress might justifiably be nervous about altering patent standards for this narrow industry—any ambiguity in the statute might take the Federal Circuit a decade to hammer out, with no guarantee that the court's solution would map onto Congress's policy concerns. In contrast, with a tax credit-based approach, Congress could be confident that Treasury would issue regulations that consciously targeted the subsidy at the intended inventors. Treasury would be able to fill the interstices of the statute with policy-motivated interpretations.

Another advantage of tax's institutional flexibility is that Congress and the Treasury Department can more easily mold the credit to the changing circumstances of the targeted industry. Continuing with the previous example, synthetic biology is still very much a developing discipline. The promise of "engineering" new genetic sequences has really only become a practical reality in the last two decades.[216] How can we be sure that any subsidy we pass today will be appropriate a decade from now? What if, in the future, the construction of new genetic sequences becomes mechanically automated?[217] Would the hypothetical subsidy cover such an eventuality? Using a responsive institution like tax should alleviate some of our worries about unknowable changes in technology and market conditions. Treasury and Congress could adapt the tax credit to the facts on the ground.

Finally, it is worth emphasizing that these tweaks by Congress and Treasury could all be quick. This is critical for emerging fields, where new technologies will frequently challenge the contours of the established subsidy regime. The sooner the law can incorporate these new developments into the scope of the subsidy (or reject them), the more quickly inventors can properly calibrate their research expenditures. Long-term uncertainty about subsidy scope will likely make inventors too conservative with their research plans, which will produce inefficiently low innovation rates.

I should note that the flexible character of tax policymaking is not without its drawbacks. One of the persistent criticisms of the research tax credit is that Congress refuses to make it permanent, which induces uncertainty and

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215. *Supra* notes 92-97 and accompanying text.

216. The key breakthroughs have been rapid DNA synthesis and standard biological parts. David Baker et al., *Engineering Life: Building a FAB for Biology*, SCI. AM., June 2006, at 44.

217. Jo Marchant, *Evolution Machine: Genetic Engineering on Fast Forward*, NEWSCIENTIST, June 27, 2011, http://www.newscientist.com/article/mg21028181.700-evolution-machine-genetic-engineering-on-fast-forward.html.

hesitation about long-term research commitments.[218] Frequent modifications of the tax credit would induce similar uncertainty. To counteract this worry, tax policymakers should err on the side of caution, particularly with retractions of the tax credit. Moreover, in mature industries—and in industries where long-term research plans are the norm—patent may be the more appropriate choice.

CONCLUSION

In this Note, I have compared patent and tax as innovation subsidies. Admittedly, this project is far from complete. I focused primarily on the comparative advantages of tax. I have argued that Congress would do well to focus on tax subsidies in a variety of research situations:

- Where the research produces many discrete inventions;
- In diffuse research environments;
- Where administrative costs are on par with research costs;
- For solo inventors and small businesses;
- Where commercialization is slow; and
- In emerging industries.

There is much work left to be done in this line of research. The most important next step will be to think carefully about how to deploy multiple innovation-encouraging institutions together. Several aspects of the status quo already reflect such a hybrid approach—for instance, the tax system treats a patent as conclusive evidence that the research is technical in nature. In this Note, I have suggested two other possibilities: first, a limited patent prosecution credit for small businesses, which are most burdened by administrative costs; and, second, a tax credit for patentees seeking to commercialize their inventions.

There is a more fundamental question, though, regarding the use of both patent and tax to stimulate innovation: why should all research qualify for both subsidies? At present there is no clear justification for why both subsidies should always be necessary. Indeed, the policy and legal analysis in this Note suggests a different baseline. The $10 billion that is distributed each year in research tax subsidies should be more narrowly targeted. Tax subsidies should

218. *See, e.g.*, GUENTHER, *supra* note 118, at 19.

be prioritized for those researchers and industries where tax can most effectively encourage optimal research decisionmaking. The list above articulates the principles policymakers should use to find these industries, several of which I have identified in this Note.

Alternatively, if narrow tailoring proves politically or practically difficult, researchers could instead simply be forced to choose either a tax credit or a patent.[219] This would, in practice, delegate the job of tailoring to the researcher herself: each researcher would have to decide which innovation subsidy is most beneficial. If the inventor were to choose the tax credit, she could receive a larger subsidy than she would have gotten had she not proved her invention was worthy of a patent. Such a system would encourage researchers who would not otherwise have bothered with the patent system to publicly disclose their discovery. It would eliminate tax credits for businesses that expect to make a large profit off the patent. And it would reduce the number of patents issued. Of course, the devil is in the details—should the researcher have to return the already-claimed credits on the research?—but such an either-or approach may present a more sensible baseline than the status quo.

This Note has also hopefully illustrated the usefulness of a comparative institutional approach. Legal academics too often assume that the best solution to an inefficiency in, for example, the law of patents is to change the law of patents. But sometimes the problem is that patent law is simply the wrong institution, where a cheaper and more productive solution would be to use tax (or prizes or grants). This is especially true in light of the deficiencies plaguing the institution of patent law that I identified in Section II.D. Tax sometimes is a second-best solution, but it may be the only solution that has a chance of becoming a reality. When crafting policy, it is not enough to ask how best to fix the problems of patent or tax. Policymakers should always also ask the prior question: which institution is the best fit for the job?

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219. Allowing inventors to make a similar choice, between prizes and patents, has been shown to be economically superior to a patent-only system. *See* Shavell & van Ypersele, *supra* note 4, at 530-31.