COMMERCIALIZATION AWARDS

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The United States has a system of intellectual property (IP) that includes patents for new and nonobvious inventions. Patents are believed to indirectly promote innovation by creating incentives to invent and thereafter commercialize inventions at a faster pace than would otherwise occur. However, theory suggests market failures, such as externalities, transaction costs, and information asymmetries in capital markets, could potentially impede commercialization of inventions that involve significant commercial risk, even when they are patented. In consequence, some scholars propose creating entirely new forms of patents, such as "commercialization patents," in order to help commercializers market their ideas and more fully appropriate returns from their investments. They argue this would spur socially beneficial entrepreneurial activity and increase the amount of information in the public domain.

This Article argues that—to the extent the alleged commercialization market failures exist—the United States already has a system of commercialization incentives that does not require creating new forms of exclusive rights: direct financing for inventors and entrepreneurs in the early stages of technology development seeking capital to fund research and operations. These are sometimes called "commercialization awards." They are currently available at the federal level in a limited form, and they are available in over half the states and some cities. Although others have interpreted these awards as inferior public alternatives to private venture capital, this Article reinterprets commercialization awards as an alternative way for government to encourage commercial risk taking in technology development.

After comparing commercialization awards to commercialization patents, this Article concludes that commercialization patents would indeed be the better choice if the goal is to incentivize business ventures that involve significant amounts of "market experimentation" that is subject to competitive free riding in the absence of IP. Examples include disruptive business models on Internet platforms like Netflix or Uber, where the first mover produces significant new information regarding consumer demand or

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overcomes costly regulatory hurdles to the benefit of later movers. Traditional invention patents do not generally protect this type of information, and there is no prima facie reason to disfavor commercial innovation over technological innovation.

However, this Article argues that commercialization awards are the better choice if the goal is to resolve market failures specifically associated with entrepreneurial risk taking in pursuing public goals, such as innovations in public health, energy, and defense. There are several reasons for preferring commercialization awards for achieving this goal. First, commercialization awards do not generate the deadweight loss and innovation-hindering effects associated with exclusive rights. Second, awards do something commercialization patents do not: they provide ex ante financing for start-ups and small businesses that cannot raise money on their own due to the capital constraints mentioned above. They also provide nonmonetary assistance in commercializing, such as business planning advice and help accessing professional investors. In order to mitigate the risks associated with government "picking winners," awards require obtaining private sector matching before money changes hands. Not only does the matching requirement improve government's valuation of inventions' commercial viability, it also has the potential to affect long-term innovation by diverting private investment away from commercial blockbusters toward innovations with long-term social benefits. In other words, matching is a way to mix public and private goals without overly distorting market outcomes.

The burden to prove commercialization market failure is on those alleging new forms of incentives. This Article concludes that, given the difficulty of producing that proof, and in light of preexisting mechanisms for overcoming similar market failures, such as commercialization awards, Congress should not introduce new forms of IP for commercialization at this time.

INTRODUCTION

From the economic perspective, the role of patents is said to be to promote innovation: invention followed by transformation of inventions into products and services that can be sold in markets to those who value

them—that is, "commercialization."[1] After all, as Joseph Schumpeter put it, "As long as they are not carried into practice, inventions are economically irrelevant."[2] However, to the extent patents promote commercialization, they do so, in Robert Merges' words, "only indirectly, through the granting of patents on inventions."[3] Ted Sichelman puts it somewhat less favorably, stating that, in the dominant theoretical model, "patent law is primarily designed to induce invention; any protection it provides to commercialization is mostly an afterthought."[4]

Some patent law scholars, including Sichelman, have suggested that as a result of patent law's single-minded focus on invention, patents are being commercially exploited at suboptimal levels.[5] By protecting only information associated with new and nonobvious technological inventions, they argue, the government neglects significant market

1. This definition of innovation, which separates invention from economically relevant innovations that achieve commercial success, has been associated with economist Joseph Schumpeter. *See* Robert P. Merges, *Commercial Success and Patent Standards: Economic Perspectives on Innovation*, 76 CALIF. L. REV. 803, 806–808, 843–46 (1988) (arguing that "the Schumpeterian perspective" is well suited for studying patent laws and laws and policies that influence innovation). This Schumpeterian perspective has been adopted by many patent law scholars. *See, e.g.*, Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1615–16 n.128 (2003) (stating, in the context of discussing the commercialization incentive of patents, that "[w]e follow Joseph Schumpeter in distinguishing between the act of invention, which creates a new product or process, and the broader act of innovation, which includes the work necessary to revise, develop, and bring that new product or process to commercial fruition"); Michael J. Burstein, *Exchanging Information Without Intellectual Property*, 91 TEX. L. REV. 227, 237–38 (2012) (same); Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 738 n.170 (2012) (same). This definition of innovation has also been associated with Edmund Kitch's prospect theory, which I discuss at length in Part I.B. *See* Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 266 (1977) (discussing a variety of functions that patents play in facilitating commercialization efforts following invention). *But see* Brett Frischmann, *Innovation and Institutions: Rethinking the Economics of U.S. Science and Technology Policy*, 24 VT. L. REV. 347, 348 (2000) (adopting a broader conception of innovation from the economic perspective that does not necessarily rely on commercialization and noting that this may be at odds with the Schumpeterian definition, under which "commercialization" and "reduction to practice" are "economic activities that elevate an invention to the status of an innovation").

2. JOSEPH SCHUMPETER, THE THEORY OF ECONOMIC DEVELOPMENT 88 (Redvers Opie trans., Harvard Univ. Press 1951) (1911).

3. Merges, *supra* note 1, at 809 ("[T]he patent system rewards *innovation* only indirectly, through the granting of patents on *inventions*.").

4. Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 344 (2010).

5. *See, e.g.*, Sichelman, *supra* note 4, at 341; *see also* Michael Abramowicz & John F. Duffy, *Intellectual Property for Market Experimentation*, 83 N.Y.U. L. REV. 337, 340 (2008) (arguing that IP for market experimentation could result in a "socially beneficial increase in market experimentation and entrepreneurial activity").

failures implicated in commercialization of inventions, including, in particular, the risk of competitive "free-riding" on information generated during commercialization itself that is not covered by invention patents.[6] Reasoning that "the economic rationale for patent protection for *ex ante* inventive efforts arguably applies with similar force for *ex post* commercialization efforts,"[7] some patent law scholars argue that Congress should create new or expanded forms of patents, such as "innovation warrants," "intellectual property (IP) for market experimentation," and "commercialization patents."[8] It is not out of the question that Congress will eventually adopt such proposals. At least 60 countries already offer "second-tier" patents with lower novelty standards.[9] Especially given the stated goal of U.S. technology policy to support entrepreneurs and spur market activity, these proposals cannot be ignored.[10]

Mark Lemley has objected to what he calls "ex post justifications" for exclusive rights, concluding that IP-based incentives to engage in conduct after invention is a "strikingly anti-market" policy that removes the discipline of competitive markets for evaluating inventions' commercial potential.[11] To the extent Lemley suggests there is no market failure, I disagree. As discussed in Part II.C, economic theory suggests

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6. Abramowicz & Duffy, *supra* note 5, at 340–41; Sichelman, *supra* note 4, at 352.

7. Sichelman, *supra* note 4, at 373–74; *see also* Abramowicz & Duffy, *supra* note 5, at 340 ("Just as patents encourage risky but ultimately beneficial technological experimentation, some form of intellectual property protection could result in a socially beneficial increase in market experimentation and entrepreneurial activity.").

8. Abramowicz & Duffy, *supra* note 5, at 340–41; Sichelman, *supra* note 4, at 345–46, 398. The "innovation warrant" could be obtained for anything, not just technology, so long as it is not available in the "ordinary course of trade." William Kingston, *Innovation Patents and Warrants*, *in* PATENTS IN PERSPECTIVE 68, 73 (Jeremy Phillips ed., 1985). The warrant would have a shorter period of exclusivity than an invention patent and would be calibrated based on the risk of investment. *Id.* at 74–76. The warrant would be "incontestable," notwithstanding subsequent technological or market developments. William Kingston, *Innovation Warrant*, *in* DIRECT PROTECTION OF INNOVATION 59, 61, 67–68 (William Kingston ed., 1987).

9. *See* Sichelman, *supra* note 4, at 397–98. For instance, Spain's *modelo de utilidad* is a 10-year patent granted based on a "relative" novelty standard. Ley 11/1986, de 20 de marzo, de Patentes [Law 11/1986 of Mar. 20, 1986 of Patents] art. 152 (BOLETÍN OFICIAL DEL ESTADO [B.O.E.] 1986, 7900). Unlike Spanish patents for which absolute novelty is required, the invention simply must result in an appreciable improvement in an object's use or manufacture. Law 11/1986 of Mar. 20, 1986 art. 143.

10. For the Office of Science and Technology Policy's stated support for entrepreneurs, see *Science, Technology and Innovation*, OFF. SCI. & TECH. POL'Y, http://www.whitehouse.gov/administration/eop/ostp (last visited Jan. 25, 2015).

11. *See* Mark A. Lemley, *Ex Ante Versus Ex Post Justifications for Intellectual Property*, 71 U. CHI. L. REV. 129, 131–32 (2004) [hereinafter Lemley, *Ex Ante Versus Ex Post Justifications*]; Lemley, *The Myth of the Sole Inventor*, *supra* note 1, at 738–45.

that a healthy innovation policy may require more than patents for inventions; it may require incentives for commercial risk taking and capital markets that are responsive to the needs of unproven technology entrepreneurs.[12]

But what participants on both sides of this debate ignore is that the United States already has a system for supporting commercialization of emerging technology when markets fail: direct government financing for inventors, start-ups, and small businesses without a significant track record (collectively, "entrepreneurs")[13] attempting to commercialize science and technology-based research, sometimes called "commercialization awards."[14] When seen in this context, ex post incentives for IP, such as commercialization patents, are not "strikingly

12. *See infra* Part II.C.

13. I use the term "entrepreneur" to mean independent inventors, start-ups, early-stage companies, and small businesses under approximately 10 years of age. *See* Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey*, 24 BERKELEY TECH. L.J. 1255, 1266–67 (2009) (discussing definition of "entrepreneur" and using proxy of companies founded in the U.S. in the last 10 years). Note, though, that this definition does not precisely fit small businesses assisted by many federal financing programs such as the Small Business Innovation Research Program (SBIR). The Small Business Administration (SBA) generally defines small business as under 500 employees. *See* 13 C.F.R. § 121.201 (2014); Eric J. Gouvin, *Of Small Businesses and Entrepreneurs: Toward a Public Policy That Supports New Venture Formation*, *in* ENTREPRENEURSHIP AND INNOVATION IN EVOLVING ECONOMIES: THE ROLE OF LAW 27, 30–35 (Megan M. Carpenter ed., 2012) (discussing differences between entrepreneurs and small businesses and asserting that even though most start-ups have very few employees, "start-up firms are responsible for generating the new jobs that policy makers usually attribute to small companies generally").

14. The existence of public commercialization financing does not go unnoticed outside IP scholarship. *See* LEWIS M. BRANSCOMB & PHILIP E. AUERSWALD, ECON. ASSESSMENT OFFICE ADVANCED TECH. PROGRAM NAT'L INST. OF STANDARDS & TECH., GCR 02-841, BETWEEN INVENTION AND INNOVATION: AN ANALYSIS OF FUNDING FOR EARLY-STAGE TECHNOLOGY DEVELOPMENT, at xi (2002) [hereinafter BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION]; Fred Block, *Innovation and the Invisible Hand of Government*, *in* STATE OF INNOVATION: THE U.S. GOVERNMENT'S ROLE IN TECHNOLOGY DEVELOPMENT 1, 18 (Fred Block & Matthew R. Keller eds., 2011); Fred Block & Matthew R. Keller, *Where Do Innovations Come From? Transformations in the US Economy, 1970-2006*, REPORTS (Information Technology and Innovation Foundation, Washington, D.C.), July 2008, at 1, 14; LEWIS M. BRANSCOMB & PHILIP E. AUERSWALD, TAKING TECHNICAL RISKS: HOW INNOVATORS, EXECUTIVES, AND INVESTORS MANAGE HIGH-TECH RISKS 176–78 (Lewis M. Branscomb & Philip E. Auerswald eds., 2001) [hereinafter BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS]; MICHAEL LIND, LAND OF PROMISE 13 (2012) (arguing that history demonstrates that the government is not the "enemy" of the private economy when it comes to innovation and technology development but its "sponsor and partner"); MARIANA MAZZUCATO, THE ENTREPRENEURIAL STATE: DEBUNKING PUBLIC VS. PRIVATE SECTOR MYTHS 21–22 (2014) (responding to perceptions that the United States does not have an active technology policy).

anti-market," as Lemley concludes.[15] They are the *pro-market* alternative to direct government financing for commercialization of emerging technologies.[16]

From the perspective of innovation policy, the question to be asking is whether new patent-based incentives for commercialization would be an improvement over existing nonpatent alternatives. If the answer turns out to be no—that commercialization awards work reasonably well at correcting market failures—then new forms of intellectual property rights (IPR) are not worth the cost. Efforts should be focused instead on improving and possibly increasing financing for awards programs. In addressing these issues, I proceed as follows.

In Part I, I lay out the theoretical framework underlying proposals for new IP-based commercialization incentives. I explain the traditional theoretical models for how patents are said to promote invention and, indirectly, commercialization, and how these traditional accounts have been modified by so-called "commercialization theory." Like others, I argue that commercialization theory is neither limited to Edmund Kitch's "prospect theory" nor limited to a single overarching model. Rather, commercialization theory (or, more accurately, commercialization theor*ies*) emphasize many distinct and sometimes divergent ways in which patents are believed to promote market-based commercialization of inventions.

In Part II, I introduce commercialization theory's new frontier: the argument that patents, as currently structured, underreward commercialization, and that consequently new forms of IPR are required. I discuss two recent proposals: patents for commercial innovations (IP for market experimentation) and exclusive rights granted in exchange for commercializing "substantially novel" products or services that are based on traditional technological subject matter (commercialization patents). Although they differ in form and, to some extent, in purpose, both proposals draw on patent commercialization theory and are based on the assumption that market failures which arise during commercialization warrant new patent rights.[17]

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15. Lemley, *Ex Ante Versus Ex Post Justifications*, *supra* note 11, at 132.

16. *But see* Mark A. Lemley, *The Regulatory Turn in IP*, 36 HARV. J.L. & PUB. POL'Y 109, 110, 114–15 (2013) (arguing that intellectual property rights (IPR) regimes, though couched in property rhetoric, have become increasingly regulatory, with patents resembling government "permissions" to enter a market).

17. "IP for market experimentation" applies to "*commercially nonobvious*" innovations (e.g., new business models) that cannot currently be patented, *see* Abramowicz & Duffy, *supra* note 5, at 342, 406, and Sichelman's commercialization patents apply to traditional technological innovations that have already been or could have been patented but were never brought to market, Sichelman, *supra* note 4, at 346. The latter may or may not involve any nonobvious commercial information. *Id.* at 403.

As already mentioned, some doubt market failure exists ex post to invention. But I go on to show that substantial literature and economic theory suggests commercialization itself can potentially implicate various market failures that potentially warrant commercialization incentives.[18] The main market failures discussed are: (1) positive externalities, including both technology spillovers and market spillovers, that significantly increase the risk of investing in commercializing inventions; (2) transaction costs related to IP licensing that can hinder commercializers in favor of IP owners; and (3) the difficulty faced by unproven entrepreneurs in capital markets, even among high-risk investors.[19] None of these market failures are necessarily eliminated by patents for new inventions. Indeed, they can be exacerbated by them.[20]

However, in Part III, I show that externalities, transaction costs, and information asymmetries are already cited as justifying commercialization incentives—just not *patent* incentives.[21] A variety of financial awards are available at the federal and state levels to help inventors, start-ups, and small businesses commercialize their inventions when markets fail.[22] The main federal program is the Small Business

18. In my discussions of possible market failures, I draw on Mankiw's popular economics textbook. *See* N. GREGORY MANKIW, PRINCIPLES OF MICROECONOMICS 11–13 (6th ed. 2012).

19. Other market failures not discussed in this Article include the situation in which commercializing an invention efficiently would require extensive collaboration between private firms, government, and universities or implementation of an industry-wide standard. *See* WENDY H. SCHACHT, CONG. RESEARCH SERV., 97-104, MANUFACTURING EXTENSION PARTNERSHIP PROGRAM: AN OVERVIEW 1–3 (2013); Stephen Martin & John T. Scott, *The Nature of Innovation Market Failure and the Design of Public Support for Private Innovation*, 29 RES. POL'Y 437, 440, 442–44 (2000).

20. *See* Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29, 32–35 (1991) (asserting that patent incentives for initial creators can impede cumulative innovation). On the problem of transaction costs, see *infra* Part II.C.3 and accompanying notes.

21. *See, e.g.*, BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION, *supra* note 14, at 1–4 (describing a perceived need for federal and state government funding sources during early-stage technology development (ESTD)).

22. In this Article, I only address federal and state commercialization awards. But federal agencies and state governments are not the only institutional actors in U.S. technology policy. Cities also provide commercialization incentives to promote local development. For an analysis of city "venture development funds" in cities such as New York, Pittsburgh, and Portland, see Abraham J. B. Cable, *Incubator Cities: Tomorrow's Economy, Yesterday's Start-Ups*, 2 MICH. J. PRIVATE EQUITY & VENTURE CAPITAL L. 195, 202–08 (2013). *See also* EDWARD GLAESER, TRIUMPH OF THE CITY (2011); BRUCE KATZ & JENNIFER BRADLEY, THE METROPOLITAN REVOLUTION (2013). Universities are also a major source of commercialization financing, sometimes in partnership with state and federal governments. On university financing for faculty "spin-outs," see Josh Lerner, *Venture Capital and Commercialization of Academic Technology: Symbiosis and Paradox*, *in* INDUSTRIALIZING KNOWLEDGE: UNIVERSITY-INDUSTRY LINKAGES IN JAPAN AND THE UNITED STATES 385 (Lewis M. Branscomb et al. eds., 1999).

Innovation Research Program (SBIR),[23] and several state governments offer similar awards in the form of cash, loans, or equity.[24] Similar to patents, their express purpose is to "accelerate" commercialization of applied science and technology-based research, and, similar to patents, they draw on private information to determine the commercial potential of inventions by requiring coinvestment, often called "matching," from private investors.[25] At the same time, government uses awards to direct investment toward inventions government thinks will lead to long-term social spillovers, such as innovations in public health and sustainable energy. We can thus think of matching as a way to mix private and public goals.[26]

Skeptics may doubt government's ability to design and administer these programs effectively.[27] In a footnote to his article proposing commercialization patents, Sichelman dismisses the possibility of government grants as an effective alternative, suggesting that experiences in other countries show that "government funding can decrease the likelihood of commercialization, particularly when firms are not required to pay back the funds in the event of failure and the government is not adept at picking commercially viable projects."[28] In

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23. 15 U.S.C. § 638 (2012).

24. *See infra* Part III.A.2.

25. *See infra* Part III.A–B.

26. This is similar to a "dual use" technology policy. *See* Maryellen R. Kelley, *From Mission to Commercial Orientation: Perils and Possibilities for Federal Industrial Technology Policy*, 11 ECON. DEV. Q. 313, 316–18 (1997) (discussing "dual-use" programs like SBIR and military procurement and arguing for a more expansive definition of "dual use" that extends beyond military applications).

27. The federal government's SBIR program in particular has its detractors. *See, e.g.*, Freedom Works, *Tell Your Senator to Support Amendments to the SBIR Reauthorization Bill to Cut Spending*, CONSERVATIVE CRUSADER (Mar. 24, 2011), http://www.conservativecrusader.com/action_items/tell-your-senator-to-support-amendments-to-the-sbir-reauthorization-bill-to-cut-spending. For the other side of this debate, see SMALL BUS. TECH. COUNCIL, TESTIMONY OF ROBERT SCHMIDT BEFORE THE COMMITTEE ON SMALL BUSINESS, UNITED STATES HOUSE OF REPRESENTATIVES, REGARDING IMPROVEMENTS TO THE SMALL BUSINESS INNOVATION RESEARCH PROGRAMS AND "UNLEASHING AMERICAN INNOVATION," NATIONAL CO-CHAIR, SMALL BUSINESS TECHNOLOGY COUNCIL, BEFORE THE COMMITTEE ON SMALL BUSINESS UNITED STATES HOUSE OF REPRESENTATIVES, REGARDING IMPROVEMENTS TO THE SBIR PROGRAMS AND "UNLEASHING AMERICAN INNOVATION" (2014) [hereinafter SCHMIDT TESTIMONY].

28. Sichelman, *supra* note 4, at 394 n.319 (citing Roger Svensson, *Commercialization of Patents and External Financing During the R&D Phase*, 36 RES. POL'Y 1052, 1067–68 (2007)). Sichelman cites Roger Svensson's study on government grants for Swedish patents. *Id.* However, Svensson's study explicitly contrasted the seemingly ineffective Swedish model with the United States, where private venture capital is more plentiful. Svensson, *supra*, at 1054. As I explain in Part III, partnering with private inventors through matching can go a long way toward alleviating the problems Sichelman mentions.

other words, Sichelman defends commercialization patents over other options based on the oft-discussed benefit of patents as "market-set" incentives that rely on the decentralized decisions of private investors rather than the government to decide whether to invest.[29] Others have made similar assessments of public venture capital programs.[30]

In Part IV, I challenge the conclusion that commercialization patents are necessarily more efficient from a utilitarian perspective than commercialization awards. Drawing on IP scholarship surrounding the "patents versus prizes" debate,[31] I show that, when it comes to evaluating the commercial potential of inventions and compensating risk-taking commercializers, both incentive mechanisms produce deadweight loss.[32] Commercialization patents would inevitably price some consumers out of the market, leading to below-optimal quantities of the innovation, and they might produce dynamic inefficiencies by restricting competition and future innovation.[33] Commercialization awards inevitably lead to some misallocated government money, and they can also produce dynamic inefficiencies by distorting private investment in innovations away from market optimums.[34]

Given the "high skew" nature of technology investing, with even the best venture capital firms (VCs) expecting only a few successes and many failures, it would indeed be very difficult for government to match the returns of private investors.[35] Government might award companies that fail so quickly the incentive becomes moot, or government might

29. *See infra* Part III.D.

30. *See infra* Part III.D.1.

31. For recent legal scholarship comparing patent and nonpatent innovation incentives, see Michael Abramowicz, *Perfecting Patent Prizes*, 56 VAND. L. REV. 115 (2003); Frischmann, *supra* note 1; Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents–Prizes Debate*, 92 TEX. L. REV. 303 (2013); Amy Kapczynski, *The Cost of Price: Why and How to Get Beyond Intellectual Property Internalism*, 59 UCLA L. REV. 970 (2012); Shaun P. Mahaffy, Note, *The Case for Tax: A Comparative Approach to Innovation Policy*, 123 YALE L.J. 812 (2013); and Joshua D. Sarnoff, *Government Choices in Innovation Funding (with Reference to Climate Change)*, 62 EMORY L.J. 1087 (2013). *See also* SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES (2004); Steven Shavell & Tanguy van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525 (2001); Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 83 AM. ECON. REV. 691 (1983).

32. Kapczynski, *supra* note 31, at 972–74.

33. On deadweight loss of patents, see generally Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031, 1058–65 (2005) (listing five separate costs of IPR: deadweight loss for consumers, reduced incentives to innovate, rent-seeking, distorted investment in research and development [R&D], and costs associated with patent prosecution and litigation). *See also* Kapczynski, *supra* note 31, at 981–82.

34. On deadweight loss of a government subsidy, see MANKIW, *supra* note 18, at 159–60. *See also infra* Part III.D.1.

35. *See infra* Part III.D.1 (discussing F.M. Scherer's work).

select companies for purely political reasons.[36] However, drawing on empirical research by Josh Lerner and others,[37] I argue that government need not be an expert investor to incentivize "marginal commercializers" effectively: inventors, start-ups, and other entrepreneurs who seek to commercialize inventions but cannot do so without some government support. By conditioning financing on matching from private investors, government can draw on private information to identify prospects that are more likely to survive. This reduces the risk of waste and distortion that normally comes with "government-set" rewards.[38]

But rather than arguing back and forth over which pricing model is more efficient in the long run—a question we do not have the information to answer[39]—I argue that which incentive is selected depends on which of the market failures identified in Part II.C we think is most problematic:[40] free riding on new information produced ex post to invention or capital constraints for technology entrepreneurs. Commercialization patents would be more effective at permitting all forms of commercial risk-takers to internalize the benefits of their investments in developing and marketing innovations that generate substantial new information upon commercialization. However, as presently designed, commercialization awards are more effective at

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36. *See infra* Part III.D.2.

37. Josh Lerner has analyzed the effects of federal SBIR awards. Josh Lerner, *The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program*, 72 J. BUS. 285 (1999) [hereinafter Lerner, *The Government as Venture Capitalist*]. A recent, similarly designed study tests the effects of a Michigan program. Bo Zhao & Rosemarie Ziedonis, State Governments as Financiers of Technology Startups: Implications for Firm Performance (July 2012) (unpublished manuscript), *available at* http://ssrn.com/abstract=2060739. Lerner has also performed significant research on the effects of government venture capital programs in other countries such as Israel and offers a variety of recommendations for improvement, including instituting matching requirements. *See* Josh Lerner, *The Boulevard of Broken Dreams*, *in* 13 INNOVATION POLICY AND THE ECONOMY 61 (Josh Lerner & Scott Stern eds., 2013) [hereinafter Lerner, *The Boulevard of Broken Dreams*, *in* INNOVATION POLICY AND THE ECONOMY]; JOSHUA LERNER, BOULEVARD OF BROKEN DREAMS: WHY PUBLIC EFFORTS TO BOOST ENTREPRENEURSHIP AND VENTURE CAPITAL HAVE FAILED AND WHAT TO DO ABOUT IT 181–91 (2009) [hereinafter LERNER, BOULEVARD OF BROKEN DREAMS: WHY PUBLIC EFFORTS TO BOOST ENTREPRENEURSHIP AND VENTURE CAPITAL HAVE FAILED AND WHAT TO DO ABOUT IT].

38. *See infra* Parts III.C–D, IV.B.

39. For a discussion of the problem of empirical uncertainty in innovation policy and policy responses, see Lisa Larrimore Ouellette, *Patent Experimentalism*, 101 VA. L. REV. (forthcoming 2015), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2294774.

40. For a similar point, see Brett Frischmann & Mark McKenna, *Comparative Analysis of Failures and Institutions in Context*, BALKINIZATION (March 11, 2014), http://balkin.blogspot.com/2014/03/brett-m.html (discussing their working paper on selective market failures and innovation incentives).

correcting market failures specific to entrepreneurial financing, especially in technology areas that align with long-term social goals.[41]

Shifting to the normative, I argue that, given the risk of deadweight loss from either incentive, the fact that commercialization awards are already in place, and the administration's current focus on entrepreneurship as a source of innovation,[42] eliminating commercialization awards would be ill advised; and introducing a new form of exclusive right to perform a similar, if not identical, function would be unnecessary.

Importantly, although this Article advises against introducing *new forms* of patents to promote commercialization, it does not resolve the issue of whether traditional U.S. patents for new and nonobvious inventions are necessary for promoting innovation or the premises of patent commercialization theory. If anything, the commercialization-awards narrative supports the notion that invention patents play a key role in facilitating commercialization of inventions. Commercialization awards supplement patents in this regard; they do not and could not replace them. This is yet another reason not to create new forms of patents that do largely the same thing that patents do already: commercialize.

I. PATENTS AND COMMERCIALIZATION

Knowledge and information-producing activities—from speech, to education, to research in new technologies—generate benefits, called positive externalities or spillovers, for those who did not pay for them.[43] Inventions and research that embody information are also traditionally regarded as public goods, meaning they are nonexcludable and

41. *See infra* Part IV.B.

42. Edward L. Glaeser & William R. Kerr, *The Secret to Job Growth: Think Small*, HARV. BUS. REV., July–Aug. 2010, at 26 ("[R]egional economic growth is highly correlated with the presence of many small, entrepreneurial employers—not a few big ones."); *see also infra* Part II.C.3.

43. Adam B. Jaffe et al., *Knowledge Spillovers and Patent Citations: Evidence from a Survey of Inventors*, 90 AM. ECON. REV. 215, 215 (2000) ("It is well understood that the non-rival nature of knowledge as a productive asset creates the possibility of 'knowledge spillovers,' whereby investments in knowledge creation by one party produce external benefits by facilitating innovation by other parties."); *see also* Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 262, 271–75 (2007) (distinguishing innovation spillovers from spillovers produced in transactions surrounding land and rival goods because of the public goods nature of innovation, the potential for productive re-use, and the comparative lack of clarity in defining and identifying IP rights); Brett Frischmann, *Spillovers Theory and Its Conceptual Boundaries*, 51 WM. & MARY L. REV. 801, 806–07, 816–21 (2009) (discussing a variety of creative activities that produce positive externalities, including speech). On positive externalities, see generally MANKIW, *supra* note 18, at 195–202.

nonrival.[44] As such, it is thought that inventions and research will be underproduced by private markets in the absence of incentives, such as patents, grants, and research and development tax credits.[45] Although there are noneconomic justifications for patents,[46] from the utilitarian perspective, patents are viewed as the most efficient of these incentive mechanisms because they facilitate the task of valuing unproven innovations and avoid the dangers of so-called "industrial policy," where government intervenes in specific industries in the economy.[47]

In the following Sections, I introduce traditional models for precisely how patents are believed to resolve problems of

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44. *See* SCOTCHMER, *supra* note 31, at 31 (2004); Joseph E. Stiglitz, *Knowledge as a Global Public Good*, *in* GLOBAL PUBLIC GOODS: INTERNATIONAL COOPERATION IN THE 21ST CENTURY 308, 308–10 (Inge Kaul et al. eds., 1999); *see also* MANKIW, *supra* note 18, at 220–21 (providing a traditional account of basic research and general knowledge as public goods). Recent scholarship challenges this traditional account of information as a public good. *See, e.g.*, Christopher S. Yoo, *Copyright and Public Good Economics: A Misunderstood Relation*, 155 U. PA. L. REV. 635 (2007) (arguing that the central feature of public goods is that they are consumed in equal quantities, which means their value is not expressed by consumer preferences, and they will be under produced); *see also* Tim Wu, *Properties of Information & the Legal Implications of Same* (Columbia Ctr. For Law and Econ. Studies, Working Paper No. 482, 2014), *available at* http://ssrn.com/abstract=2446577 (discussing work including Yoo's objecting to the notion that information is inherently nonexcludable).

45. *See* SCOTCHMER, *supra* note 31, at 38 ("Intellectual property protection gives innovators an incentive to invest in new knowledge. However, intellectual property protection is not the only way to do that."); Stiglitz, *supra* note 44, at 311 (noting that patents are part of a broader class of incentives by which government enhances the ability of innovators to appropriate the value of their inventions); Michael J. Graetz & Rachael Doud, *Technological Innovation, International Competition, and the Challenges of International Income Taxation*, 113 COLUM. L. REV. 347, 349–50 (2013); Hemel & Ouellette, *supra* note 31, at 311–12.

46. *See* Adam Mossoff, *Who Cares What Thomas Jefferson Thought About Patents? Reevaluating the Patent "Privilege" in Historical Context*, 92 CORNELL L. REV. 953, 968–69 (2007) (demonstrating that exclusive "privileges" were justified on the basis of protecting natural rights in intellectual creations, not simply as economic incentives); *see also* ROBERT P. MERGES, JUSTIFYING INTELLECTUAL PROPERTY 9–19 (2011) (arguing that IP depends on economic as well as noneconomic theories of rights, especially Locke's labor theory, Kant's autonomy theory, and Rawls's theory of distributive justice); Eric R. Claeys, *On Cowbells in Rock Anthems (and Property in IP): A Review of Justifying Intellectual Property*, 49 SAN DIEGO L. REV. 1033, 1035–37 (2012) (suggesting that IP expresses and internalizes the noneconomic foundations Merges justifies through midlevel mechanisms different from the mechanisms Merges considers).

47. *See* SCOTCHMER, *supra* note 31, at 97 ("A virtue of intellectual property as an incentive mechanism is that it decentralizes decision making."); *see also* MANKIW, *supra* note 18, at 202 (comparing patents to "industrial policy" options for confronting externalities and noting economists' skepticism of the latter). *But see* Kapczynski, *supra* note 31, at 974–75 (challenging the view that property rights are a superior way to induce investment in information because they "harness the power of price to transmit information between consumers and decentralized creators" and noting that this view is "so deeply internalized in the field of IP law that it is taken for granted").

underinnovation in the private sector. I then introduce patent commercialization theory, starting with Kitch's so-called prospect theory and moving to the work of later scholars that build on, or in some cases significantly diverge from, Kitch. My reason for exhaustively reviewing these frameworks is to deepen understanding of the new proposals for commercialization patents introduced in Part II, which build and expand on many of the premises of commercialization theory.

A. Traditional Justifications for Patents

In the traditional utilitarian model, by providing the exclusive right to make, sell, use, offer for sale, and import a claimed invention for 20 years,[48] patents promote innovation by generating three main types of incentives, each of which was described by Fritz Machlup in his influential review of the patent system in 1958: 1) incentive to invent, 2) incentive to disclose, and 3) indirect incentive to commercialize.[49]

First, by giving inventors the opportunity to obtain exclusive rights to make, use, and sell novel and "nonobvious" inventions for 20 years, patents give inventors an increased incentive to derive new inventions, secure in the knowledge that they will be protected from copying and competition for a limited period.[50] The second traditional justification for patents is that, by mandating disclosure of inventions in exchange for an exclusive right, patents encourage inventors to reveal information they might otherwise keep secret and thereby impart useful technical subject matter to others.[51] The third justification is that patents encourage investment in developing and commercially exploiting patented inventions, since patents only have economic value if the underlying inventions come to have economic value.[52] Patents' indirect

48. *See* 35 U.S.C. § 154 (2012) (describing the contents and term of a patent right); *id.* § 102 (novelty); *id.* § 103 (non-obviousness).

49. *See* SUBCOMM. ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE COMM. ON THE JUDICIARY, 85TH CONG., AN ECONOMIC REVIEW OF THE PATENT SYSTEM 21 (Comm. Print 1958) (report by Fritz Machlup). Others have framed traditional incentives theory in similar ways. *See, e.g.*, Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017, 1024–30 (1989) (noting that the primary utilitarian justifications for patents are the incentive-to-invent and incentive-to-disclose theories, and going on to note Edmund Kitch's contributions focusing on innovation as including commercialization).

50. SUBCOMM. ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE COMM. ON THE JUDICIARY, *supra* note 49, at 21 (describing the "reward by monopoly" justification for patents).

51. *Id.* (describing the "exchange-for-secrets" justification for patents); *see also* § 112(a).

52. SUBCOMM. ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE COMM. ON THE JUDICIARY, *supra* note 49, at 21 (describing the "monopoly profit-incentive" feature of patents, which assumes patents are "the simplest, cheapest, and most effective way"

pull toward the market was noted by Adam Smith and nineteenth century luminaries like Justice Story.[53]

B. Commercialization Theory/ies

Although the notion that patents indirectly promote commercialization by creating exclusive rights in inventions has a strong theoretical and historical basis, some scholars suggest that focusing only on traditional justifications for patents, which center around invention and disclosure, underappreciates the patent system's significant role in promoting commercialization following invention. This argument can be traced to a 1977 article by Edmund Kitch.[54] But, as I will discuss, commercialization theory goes beyond "prospect theory" and beyond Kitch.[55]

1. BEYOND PROSPECT THEORY

In *The Nature and Function of the Patent System*, Kitch asserted that focusing on a patent as merely a "reward" for invention is "incomplete" because patents' main role lies in incentivizing and coordinating commercialization of inventions after patenting.[56] Kitch's

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"[t]o make it worthwhile for inventors and their capitalist backers to make their efforts and risk their money" in "inventions and/or their exploitation"); *see also* Merges, *supra* note 1, at 809–10.

53. ROBERT PATRICK MERGES & JOHN FITZGERALD DUFFY, PATENT LAW AND POLICY: CASES AND MATERIALS 7–8 n.20 (4th ed. 2007) (quoting ADAM SMITH, LECTURES ON JURISPRUDENCE 82–83 (R.L. Meek et al. eds., 1978)). Adam Smith wrote:

> For if the legislature should appoint pecuniary rewards for the inventors of new machines, etc., they would hardly ever be so precisely proportioned to the merit of the invention as this is. For here, if the invention be good and such as is profitable to mankind, he will probably make a fortune by it; but if it be of no value he also will reap no benefit.

Id.; *see also Lowell v. Lewis*, 15 F. Cas. 1018, 1019 (C.C.D. Mass. 1817) (No. 8,568) ("whether [the invention] be more or less useful is a circumstance very material to the interests of the patentee").

54. *See* Kitch, *supra* note 1.

55. *See, e.g.*, Burstein, *supra* note 1, at 239–40; Sichelman, *supra* note 4, at 374–76; *see also* Christopher Buccafusco et al., *Experimental Tests of Intellectual Property Laws' Creativity Thresholds*, 92 TEX. L. REV. 1921, 1925–26 n.12 (2014) (noting that "utilitarian thinking [in patent law] comes in different flavors" and going on to mention three theories related to commercializing patents that I decouple in the following Sections, including Kitch's prospect theory, Abramowicz and Duffy's approach advocating commercialization, and Long's patent signaling theory).

56. *See* Kitch, *supra* note 1, at 266 ("The reward theory is not questioned on its own terms. Rather, it is argued that the reward theory offers an incomplete view of the functions of the patent system.").

most discussed proposition in this regard is so-called "prospect theory."[57] Making an analogy to mineral rights prospects, Kitch asserted that, especially when granted broadly and early in development, patents "manage" the search for technological information by granting development rights to a single owner who can then coordinate the direction of research and exchange information with others more efficiently than if all were working competitively in secret.[58] At the same time, patents avoid wasteful duplication of research efforts by signaling to others in the field that the invention is being developed and to stop work in that area or coordinate with the patent owner.[59]

Scholars like Merges and Richard Nelson have questioned Kitch's suggestion that granting one firm early control over the development of an invention is desirable, particularly in light of transaction costs in IP licensing that might reduce the ability of the patent holder to outsource and cross license with others in the field.[60] The result, they argue, would be to reduce collective contributions to the innovation process—achieving the benefit of reducing waste but eliminating the benefit of having "many minds" confront a particular problem.[61] In a similar vein, Lemley and Dan Burk have criticized prospect theory on the ground that it is linked to a Schumpeterian view of innovation, in which it is assumed that the cost of research and true innovation necessitates large firms rather than small firms operating in competitive markets.[62]

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57. *Id.*

58. *Id.* at 266, 269, 276 ("[A patent] puts the patent owner in a position to coordinate the search for technological and market enhancement of the patent's value so that duplicative investments are not made and so that information is exchanged among the searchers."); *see also id.* at 283–85 (suggesting that efficiency of unification of control and pioneer patents allow a more efficient research strategy).

59. *Id.* at 278 (arguing that patents lead to less wasteful duplication of effort via signaling). "[A] patent system enables firms to signal each other, thus reducing the amount of duplicative investment in innovation." *Id.*

60. Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 873–74 (1990).

61. *See id.*; *see also* Roberto Mazzoleni & Richard R. Nelson, *Economic Theories About the Benefits and Costs of Patents*, 32 J. ECON. ISSUES 1031, 1042 (1998) (contending that broad early patents would reduce "the number of diverse inventors who would be induced to work on the prospect" by the lure of a patent "down the road," inasmuch as their ability to work on that patent "would be constrained by their ability to negotiate a license"). Notably, Nelson does *not* critique "development and commercialization" theory, which he treats separately from prospect theory. *See id.* at 1033, 1040–42.

62. DAN L. BURK & MARK A. LEMLEY, THE PATENT CRISIS AND HOW COURTS CAN SOLVE IT 72 (2009); *see also* Merges, *supra* note 1, at 843 (discussing Schumpeter's third principle concerning innovation, which states that "an industry structure that encourages competition among many small firms is not the best structure for fostering technological innovation" because "the expense of conducting research" implies that

"On this view," they write, "only strong rights to preclude competition will effectively encourage innovation."[63]

Some suggest that Kitch's contribution is limited to prospect theory, and that prospect theory is inherently intertwined with a preference for large corporations and consolidated market structure.[64] However, as Sichelman and, more recently, Stephen Yelderman observe, Kitch's emphasis on commercialization is not necessarily limited to his contention that early, broad patents efficiently consolidate the rights to develop an invention in a single owner.[65] A close reading of Kitch's article reveals several distinct ways in which he believed patents facilitate commercialization. All are important for thinking about how patents might incentivize and facilitate commercialization and have appeared in later scholarly debates.

a. Supranormal incentive to commercialize

Patents, Kitch wrote, give owners incentives "to make investments to maximize the value of the patent without fear that the fruits of the investment will produce unpatentable information appropriable by competitors."[66] This incentive to commercialize may be indistinguishable from the "indirect" incentive noted above,[67] but it is nonetheless significant. Scholars like Amy Kapcynski, Talha Syed, and Peter Lee suggest the incentive-to-commercialize feature of patents can distort investment toward innovations likely to yield profits in the presence of

"large firms are necessary to keep the engine of capitalist change [produced by technological innovation] going").

63. BURK & LEMLEY, *supra* note 62, at 72.

64. *See, e.g.*, *id.* (associating Kitch with Schumpter).

65. *See* Ted Sichelman, *Markets for Patent Scope*, 1 IP THEORY 42 (2010); Stephen Yelderman, Coordination-Focused Patent Policy 13 (Aug. 15, 2014) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2481025 (arguing that even though "Kitch noted a variety of ways that the patent system could increase the output from resources used for technological innovation, subsequent commentators have . . . not consistently distinguished among these various, alternative uses of the patent system"); s*ee also, e.g.*, Anna B. Laakmann, *An Explicit Policy Lever for Patent Scope*, 19 MICH. TELECOMM. & TECH. L. REV. 43, 50–51 (2012) (noting that in addition to incentives patents "can add value by fostering collaborative relationships that might not otherwise form").

66. Kitch, *supra* note 1, at 276.

67. *See* Hemel & Ouellette, *supra* note 31, at 361 ("It may be that the winner-takes-all incentive of a patent is the key driver of innovation, but this is simply a restatement of one of the main arguments for *ex post* mechanisms over *ex ante* mechanisms, as we have already discussed.")

patents and away from socially valuable innovations that patents (and markets themselves) do not reward.[68]

b. Increased protection from copying inside and outside the firm

By creating a legal obligation not to copy information related to patented inventions, patents facilitate transactions around inventions, which according to Kitch would be more difficult in the presence of only trade secret regimes.[69] This contention, related to the so-called Arrow Information Paradox, has been debated in the patent and trade secrets literature. Most recently, Michael Burstein argued that patents are not necessarily required for exchanging information effectively.[70] Relatedly, Kitch suggested that patents can reduce the cost of preventing leaks *within the firm*.[71] This is also debated, with scholars like Lemley suggesting that trade secret laws do a better job of reducing the cost of preventing leaks.[72]

c. Avoid distortion of innovation

Lastly, Kitch noted that patents may avoid over investment in process inventions that are easier to keep secret.[73] The suggestion that

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68. *See* Amy Kapczynski & Talha Syed, *The Continuum of Excludability and the Limits of Patents*, 122 YALE L.J. 1900, 1905 (2013) (arguing that "patents will systematically underreward research because they yield less than full appropriability"); Peter Lee, *Social Innovation*, 92 WASH. U. L. REV. 1 (2014) (arguing that patents alone are not sufficient to incent generation of certain socially valuable innovations, but showing that charitable foundations and government funding nonetheless support these types of innovation).

69. Kitch, *supra* note 1, at 277 ("[A] patent system lowers the cost for the owner of technological information contracting with other firms possessing complimentary information and resources.").

70. *See* Burstein, *supra* note 1, at 231 (arguing that a range of strategies are used to engage in information exchange, of which IP is only one). A key question in this debate is whether patent or trade secret laws more efficiently achieve information exchange. *See* Michael Risch, *Why Do We Have Trade Secrets?*, 11 MARQ. INTELL. PROP. L. REV. 1, 24–25 (2007) (listing "the bundle of rights" provided by trade secret laws, including "[t]he right to transfer, devise, or otherwise make exclusive grants of certain information").

71. *See* Kitch, *supra* note 1, at 279 ("Resources devoted to keeping the technology secret are saved.").

72. Trade secret laws are another way to lower the cost of leaks. *See* Mark A. Lemley, *The Surprising Virtues of Treating Trade Secrets as IP Rights*, 61 STAN. L. REV. 311, 313 (2008) (arguing that strong trade secret laws may be a less costly mechanism than patent law to increase information disclosure within and between firms by creating remedies for misappropriation of information that firms would otherwise keep secret).

73. *See* Kitch, *supra* note 1, at 279 ("Trade secrets create special incentives for processes that can be efficiently practiced in secrecy by a single firm. . . . A patent system

investments would go toward process inventions rather than products in the absence of patents has some support in economic history.[74] That said, scholars like Kapcynski and Syed point out that patents themselves can also cause technology-specific distortions, leading to less investment in innovations that are inherently difficult to exclude and for which the prospect of more exclusivity provides only weak incentive.[75]

2. COMMERCIALIZATION THEORY/IES BEYOND KITCH

Kitch's framework has evolved and branched off in later scholarship to encompass a larger family of commercialization theory or, more accurately, commercialization theories. In addition to the advantages highlighted by Kitch, post-Kitch commentators have illuminated related ways in which patents and the patent system facilitate commercialization or make the process of commercializing inventions more efficient.[76] None necessarily turns on the importance of broad, early patents held by single firms, and some directly contradict prospect theory's assumptions. I discuss each development and important critiques below.

a. Eliminating Free Riding on Information Produced Post Invention

The first development is closely related to Kitch's general assertion that patents play a role well beyond invention,[77] but it provides a more specific reason for this role: the significant informational component of commercialization itself. This argument has been made from various angles. For instance, R. Polk Wagner has argued that patents only allow full appropriation of specific information directly disclosed in a patent, and that other information, such as that produced from improving on or from "inventing around" patents, can never be fully appropriated; thus, assuming IPR create incentives to innovate, more IPR will lead to more information in the public domain.[78] John Duffy emphasizes that practiced

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covering all the useful arts provides a uniform structure of incentives without regard to the possibility of economic exploitation in secret.").

74. *See* Petra Moser, *How Do Patent Laws Influence Innovation? Evidence from Nineteenth-Century World Fairs* (Nat'l Bureau of Econ. Research, Working Paper No. 9909, 2003), *available at* http://www.nber.org/papers/w9909.pdf (finding based on records of inventions from 19th century world fairs that national patent laws did not increase levels of innovation but influenced the distribution of innovative activity across industries).

75. *See* Kapczynski & Syed, *supra* note 68, at 1905.

76. For Michael Bustein's recent discussion of post-Kitch scholarly developments in commercialization theory, see Burstein, *supra* note 1, at 239–45.

77. Kitch, *supra* note 1, at 275–80.

78. R. Polk Wagner, *Information Wants to Be Free: Intellectual Property and the Mythologies of Control*, 103 COLUM. L. REV. 995, 1017–22 (2003).

inventions produce far more information than unworked inventions that are disclosed in "[m]ere paper patents."[79] As I will discuss further in the next Section, Duffy and Michael Abramowicz, along with others, have argued in several contexts that investments in *post-invention activities*—such as developing commercial applications, raising capital, production, distribution, market testing, and marketing—all produce information that may benefit others who did not make the investments. In other words, commercialization, like invention, produces spillovers that are vulnerable to competitive free riding by second movers.[80]

Although they emphasize the necessity of patents for inducing optimal levels of innovation and commercialization, these scholars do not necessarily assume that a single entity will more efficiently "manage" the commercialization process: spillovers can be just as detrimental, if not more detrimental, to small innovators operating in a highly competitive market. But nonetheless, as discussed further in Part II, skeptics like Lemley and Brett Frischmann go beyond critiques of prospect theory, arguing that spillovers post invention should not be contained because full internalization is not necessary to optimize investment in innovation, and the cure of creating more IPR is worse than the alleged problem.[81]

b. Accelerating Innovation

Another strand of commercialization theory posits that even if patents do not increase the overall amount of inventions that are derived and brought to market, patents accelerate the pace at which innovations

79. *See* John F. Duffy, *Reviving the Paper Patent Doctrine*, 98 CORNELL L. REV. 1359 (2013) (proposing reviving a doctrine that discounts nonworked patents in favor of worked patents because commercialization entails far more risk and information production than a patent alone).

80. *See, e.g.*, Michael Abramowicz, *The Danger of Underdeveloped Patent Prospects*, 92 CORNELL L. REV. 1065, 1094 (2007) (discussing "three types of development activities—scientific experimentation, market experimentation, and marketing—that . . . a patentee cannot protect with intellectual property rights"); *see also* Abramowicz & Duffy, *supra* note 5, at 340 (discussing the risk of under investment in commercially nonobvious innovations due to the risk of free riding); F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697, 708 (2001) (asserting that, once incurred, costs borne by first movers, including developing commercial applications, raising capital, and establishing production facilities and distribution channels, "will yield benefits for the entire class of competitors"); Sichelman, *supra* note 4, at 372–77 (discussing the risk of free riding on first movers' investments and arguing that it contributes to an "under-commercialization problem").

81. *See, e.g.*, Frischmann & Lemley, *supra* note 43, at 257–58 (questioning whether "complete internalization of externalities is necessary to optimize investment incentives"); Lemley, *supra* note 33, at 1032 (arguing that the introduction of real property's free-riding "rhetoric" into intellectual property results in an overemphasis on containment of spillovers).

enter the public domain and go into public use. Studies by Edwin Mansfield and others in the same vein show that basic research, whether performed in firms or in universities and government labs, can lead to new industrial and commercial applications that generate significant social value.[82] But this takes time.[83] Patent scholars like Duffy, Abramowicz, and T.J. Chiang argue that patents may accelerate the pace at which innovation occurs.[84] As Chiang puts it, "[T]he benefit [of patents] is not only that we *receive* the invention earlier, it is also that we can *use* the invention during [the] entire period [of the patent term] even though the invention is under monopoly."[85] Paying monopoly prices for a period of years is better than having no access at all to a socially valuable innovation.[86] Duffy provides a mechanism through which patents accomplish this acceleration effect through racing.[87]

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82. For a discussion of Mansfield's work and other studies measuring private and social returns from research through various channels, see Bronwyn H. Hall, *The Private and Social Returns to Research and Development*, *in* TECHNOLOGY, R & D, AND THE ECONOMY 140 (Bruce L. R. Smith & Claude E. Barfield eds., 1996). Hall discusses studies measuring private returns from doing R&D within the firm, *id.* at 145–48, private returns to public research and development performed with federal funding within firms or in universities and government labs, *id.* at 148–55, and the effects of basic science research on industrial and commercial innovation (i.e., the social returns of academic research), *id.* at 155–59.

83. For example, in one important study, Mansfield estimated a time lag of about six to seven years between academic research findings and commercialization of innovations based on those findings in various manufacturing industries. *See* Edwin Mansfield, *Academic Research and Industrial Innovation*, 20 RES. POL'Y 1, 4–5, 6 tbl.3, 11 (1991). The time lags differed depending on how important the academic research findings were perceived to be for introducing the innovations and on whether the firms were small or large. *Id.* at 4–5.

84. Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590, 1599 (2010) [hereinafter Abramowicz & Duffy, *The Inducement Standard of Patentability*] (noting that a "growing body of literature . . . views the patent system as attempting not so much to increase but to accelerate innovation"); Tun-Jen Chiang, *A Cost-Benefit Approach to Patent Obviousness*, 82 ST. JOHN'S L. REV. 39, 57–58 (2008) ("[W]hile virtually every invention would be created sooner or later even without a patent system, patents creat[e] incentives for additional research investment, leading to inventions being made sooner than they otherwise would be. The patent system creates no inventions, it *accelerates* them."); John F. Duffy, *Rethinking the Prospect Theory of Patents*, U. CHI. L. REV. 439, 443–46 (2004).

85. Chiang, *supra* note 84, at 42.

86. *Id.* at 41–42 (using the hypothetical example of a cure for AIDS).

87. Duffy, *supra* note 84. While not disagreeing with Kitch that patenting facilitates commercialization, Duffy questioned Kitch's assertion that the benefit of granting patents early in the innovation process is to avoid duplicative research efforts. *Id.* Instead, Duffy argued, early patenting serves to put innovations in the public domain *faster* than would otherwise occur due to the incentives generated by the competition to be first. *See id.* at 443–44, 464–75. For a recent discussion of Duffy's critique of Kitch, see also Hemel & Ouellette, *supra* note 31, at 360–61.

c. The Transactional Role of Patents

Another key proposition, noted by Kitch, is that patents are effective in promoting commercialization of inventions not simply due to the pure incentive value of an exclusive right; rather, patents also facilitate the exchange of new information and reduce the costs of dealing with others—for instance, to exchange new information or to obtain inputs for a technological venture.[88] The "transactional role" of patents has been developed significantly since Kitch in work by Merges[89] and Scott Kieff,[90] who argue that one of the key functions of patents is that, like other property rights, they facilitate the disclosure[91] and transfer of

88. *See* Kitch, *supra* note 1, at 277 ("[A] patent system lowers the cost for the owner of [a patent covering] technological information of contracting with other firms possessing complimentary information and resources.").

89. *See, e.g.*, Robert P. Merges, *A Transactional View of Property Rights*, 20 BERKELEY TECH. L.J. 1477 (2005) [hereinafter Merges, *A Transactional View of Property Rights*]. Although Merges's work discussing the transactional value of patents assumes and explains the value of patents in promoting commercialization, Merges is not a proponent of prospect theory. *See, e.g.*, Merges & Nelson, *supra* note 60, at 871–78. Unlike Kitch, Merges assumes patent rights' major benefit lies in facilitating transactions and collaboration among *disperse actors*, not management by a single party. *See, e.g.*, *id.* at 871–73. As discussed in Part II.C.2, the major problems that arise in this framework are overbroad patents and, even more so, transaction costs that limit patent licensing. *See, e.g*, *id.* at 873–74 (objecting to Kitch's prospect theory on the ground that it would lead to over consolidation of innovation especially in the presence of transaction costs). Also, Merges does not share the conviction of commercialization theorists like Abramowicz and Duffy that patents' value should be judged primarily on whether they "induce" commercial innovations. *See* Abramowicz & Duffy, *supra* note 84, at 1599; Robert P. Merges, *Uncertainty and the Standard of Patentability*, 7 HIGH TECH. L.J. 1, 2–3 (1992) [hereinafter Merges, *Uncertainty and the Standard of Probability*]. Rather, Merges suggests patents' incentive value should be judged on whether the existence of a patent system causes the marginal inventor to undertake R&D whose technical and commercial success is highly "uncertain" at the outset. Merges, *Uncertainty and the Standard of Patentability*, *supra*, at 2–3.

90. Kieff's framework for patents is similar to Kitch's, but he provides a more nuanced law-and-economics treatment of the role of patents as property rights in "the commercialization process itself," with commercialization defined as the "collective act of transmitting benefit from nascent inventions to those other than the inventor." *See* Kieff, *supra* note 80, at 705 n.27, 707 n.47 (noting the relation to Kitch's prospect theory); *see also* F. Scott Kieff, *On the Economics of Patent Law and Policy*, *in* PATENT LAW AND THEORY: A HANDBOOK OF CONTEMPORARY RESEARCH 3, 3 (Toshiko Takenaka ed., 2008) ("The basic theme is that enforcing patents as property rights can improve the socially constructive coordination that facilitates the complex process of commercializing innovation thereby improving both access and competition.").

91. Whether patent specifications directly "teach" useful information to other innovators is subject to debate. *See, e.g.*, Lisa Larrimore Ouellette, *Do Patents Disclose Useful Information?*, 25 HARV. J.L. & TECH. 545 (2012). But the traditional disclosure model does not account for the informal disclosures that patents facilitate during deals surrounding licensing, sale, and/or development. *See* Merges, *A Transactional View of*

information related to an innovation from those who generate it to those who can most efficiently develop and use it.[92] Patents' transactional role is highly relevant to debates over nonpracticing entities (NPEs), so-called patent trolls, whose primary business model is acquiring, licensing, and enforcing patents generated by others.[93] For scholars like Merges, the main problem that arises in this context is transaction costs in IP licensing, such as "patent thickets" and "patent hold-ups" that can hinder efficient transfer of rights.[94]

d. Patents' Role in Entrepreneurship

A particularly important transactional function of patents during commercialization is said to be that they help entrepreneurs commercialize their inventions by facilitating disclosure and/or transfer of information, especially during fundraising.[95] According to "patent signals" theory, even apart from what they reveal or allow to be revealed, patents alleviate informational asymmetries in entrepreneurial financing by signaling the quality of a technological venture to potential investors.[96] As discussed in Part II.C.2, the extent to which this theory

Property Rights, *supra* note 89, at 1500–01 (discussing the larger variety of informational disclosures that patents permit).

92. *See* Merges, *A Transactional View of Property Rights*, *supra* note 89, at 1481–82 (citing Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 351–53) (1967)) (discussing the relevance of Harold Demsetz and property theory to patent law); *see also* Kieff, *supra* note 80, at 703 ("[T]he treatment of patents as property rights is necessary to facilitate investment in the complex, costly, and risky commercialization activities required to turn nascent inventions into new goods and services.").

93. *See* Michael Risch, *Licensing Acquired Patents*, 21 GEO. MASON L. REV. 979 (2014) [hereinafter Risch, *Licensing Acquired Patents*] (discussing various theories about the commercialization benefits of patent licensing by both commercializers and NPEs); Michael Risch, *Patent Troll Myths*, 42 SETON HALL L. REV. 457 (2012) (challenging much of the conventional wisdom about "trolls" and nonpracticing entity plaintiffs in general); *see also* Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 COLUM. L. REV. 2117 (2013) (arguing that many of the problems associated with trolls are in fact problems that stem from disaggregation of complimentary patents into multiple hands). For a recent review of these types of critiques among academics, politicians, and the media, see Ryan T. Holte, *Trolls or Great American Inventors: Case Studies of Patent Assertion Entities*, 59 ST. LOUIS U. L.J. (forthcoming 2015).

94. *See infra* Part II.C.2 (discussing Coase and transaction costs).

95. *See* Kitch, *supra* note 1, at 277 (noting that patents facilitate financing by permitting disclosure); Merges, *A Transactional View of Property Rights*, *supra* note 89, at 1500–01.

96. *See* Clarisa Long, *Patent Signals*, 69 U. CHI. L. REV. 625, 653 (2002) (positing patents may be used to signal quality of a start-up); *see also* Mark A. Lemley, *Reconceiving Patents in the Age of Venture Capital*, 4 J. SMALL & EMERGING BUS. L. 137, 143–44 (2000) (discussing patents' increasing use as financing tools with the advent

applies in the real world has been debated. But the most recent studies indicate that entrepreneurs at least appear to view patents as important tools for raising capital.[97]

A related argument, raised by scholars like Sichelman and Sean O'Connor, is that new or young companies that hold patents can achieve a competitive advantage over better-capitalized and better-networked incumbents, serving as "slingshots" that propel entrepreneurs into the marketplace against the Goliaths.[98]

II. COMMERCIALIZATION THEORY'S NEW FRONTIER

Commercialization theory is not merely academic. It had significant traction in the pharmaceutical industry, where costs of development are high, testing times are long, copying by generics is easy, and regulatory barriers are extensive—leading many to agree that the most sufficient solution is to confer exclusive rights to research and market drugs on a single owner.[99] It was also influential in informing Congress's decision in the early 1980s to allow and encourage beneficiaries of government research funding to hold title to their patents, with the stated goal of pushing basic or early stage research into the marketplace—often referred to as "technology transfer."[100] Indeed, the commercialization

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of venture capitalist financing and venture capitalists' "love-hate relationship" with patents).

97. Graham et al., *supra* note 13, at 1303–09; *see also id.* at 1263 (finding that many of entrepreneurs' motivations in patenting have "little to do with the classical incentives and free rider stories"); *id.* at 1285 (reporting on weak incentive value of patents).

98. For a theoretical discussion of the important role of patents for entrepreneurs, see *id.* at 1258–59; *see also* Ted Sichelman & Stuart J.H. Graham, *Patenting by Entrepreneurs: An Empirical Study*, 17 MICH. TELECOMM. & TECH. L. REV. 111, 112–15 (2010). For the slingshot metaphor, see Ted Sichelman & Sean O'Connor, *Patents As Promoters of Competition: The Guild Origins of Patent Law in the Venetian Republic*, 49 SAN DIEGO L. REV. 1267, 1269–70 (2012) (suggesting that in markets otherwise dominated by the guilds in early Venice, rather than dampening competition, exclusive privileges helped innovative new entrants enter markets that would otherwise be dominated by incumbents, serving as a slingshot for the "David[s]" against the "Goliath[s]").

99. *See, e.g.*, W. Nicholson Price II, *Making Do in Making Drugs: Innovation Policy and Pharmaceutical Manufacturing*, 55 B.C. L. REV. 491 (2014) (arguing that IP incentives to innovate in pharmaceutical manufacturing are too low, but that patents play a strong role in incentivizing innovation in drugs). Even Lemley has suggested prospect theory is useful for framing the role of patents in the pharmaceutical industry. Lemley, *Ex Ante Versus Ex Post Justifications*, *supra* note 11, at 141.

100. Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663, 1668–69 (1996). On patent-mediated technology transfer, see Peter Lee, *Transcending*

policy motivating the Bayh Dole Act relies on the assumption that patents are an effective way to promote technology transfer and commercialization, whether through universities, government labs, or through small businesses receiving government funds.[101] Since its enactment, U.S. universities have created technology transfer offices to facilitate the licensing of university inventions to the corporate sector for commercialization.[102]

Today, some scholars have taken commercialization theory to a new frontier, proposing new forms of patents to do what invention patents are said to do already: increase and accelerate the pace of commercialization and spur market activity and entrepreneurship.[103] In the next Section, I explain the two most recent proposals, their theoretical foundations, and Lemley's influential critique of ex post justifications for IP—which I show applies with even greater force to these proposals than it does to classic commercialization theory.

A. New Commercialization Patent Proposals

The argument for new patent-based commercialization incentives rests on the theoretical, if not fully empirical,[104] premise that U.S. patents currently provide insufficient incentives to commercialize inventions, especially for small businesses and entrepreneurs. The proposals come in two flavors: patents of broader scope that protect "commercially nonobvious" information and promote commercial risk taking and "commercialization patents" granted in exchange for a commitment to make and sell "substantially novel" products or services involving new technology.

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the Tacit Dimension: Patents, Relationships, and Organizational Integration in Technology Transfer, 100 CALIF. L. REV. 1503 (2012).

101. Eisenberg, *supra* note 100, at 1663–65 (discussing the policy behind the Bayh Dole Act and the SBIR to use patents to promote the generation of applied research, to encourage private investment, and to transfer research into the market).

102. David C. Mowery & Bhaven N. Sampat, *The Bayh-Dole Act of 1980 and University-Industry Technology Transfer: A Model for Other OECD Governments?*, 30 J. TECH. TRANSFER 115, 119 (2005).

103. For this point, see Burstein, *supra* note 1, at 240 (observing that "the logic of providing incentives for commercialization can extend beyond the patent system as it currently exists").

104. Abramowicz & Duffy, *supra* note 5, at 342 (arguing that strong theoretical arguments exist suggesting that the existing level of market experimentation is too low, though empirical proof is difficult to obtain); Sichelman, *supra* note 4, at 380 (describing "theoretical arguments and empirical evidence showing that the patent system, in significant part, very likely causes low rates and elongated timelines of commercialization for many valuable patented inventions").

1. PATENTS FOR MARKET EXPERIMENTATION

In their influential article, *Intellectual Property for Market Experimentation*, Abramowicz and Duffy argue that U.S. patent law protects information associated with technological experimentation but unjustifiably neglects information associated with "market experimentation," which they define as "the commercial test of a product or service that is new to the market in which it is launched and that has uncertain prospects for commercial success."[105] After all, they observe, testing how products and services perform in a new market, just like testing how new technology performs in a lab, can produce new information that is difficult to value ex ante and that may be vulnerable to free riding.[106]

Examples of "market experimentation" that might benefit from exclusive rights include experimenting with a never-before-tested business model, such as Netflix's model of renting out DVDs over the Internet,[107] or entering a new geographic market, such as by opening an Ethiopian restaurant in a location which has none.[108] In each case, the first mover's investments in market experimentation produces valuable "information about whether consumer demand and other market conditions will permit commercial success" that benefits competitors and future innovators who did not pay for it.[109]

Emphasizing the virtues of patents for promoting technological innovation, Abramowicz and Duffy suggest that "commercialization patents" should potentially be available for these types of ventures as well, so long as they involve information that is "commercially new and nonobvious" and vulnerable to free riding by others.[110] Although they provide no single definitive proposal, Abramowicz and Duffy briefly suggest a few ways through which patenting of market innovations could be accomplished, including allowing regular patents for "smallish variations" of previously failed innovations or for products that have never been effectively commercialized.[111]

In his follow-up article, Abramowicz built on this framework, proposing similar forms of exclusive rights for "*orphan* business models, that is, business models previously conceived and disclosed that no one

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105. Abramowicz & Duffy, *supra* note 5, at 339 & n.4.

106. *Id.* at 341 (comparing spillovers from market experimentation to spillovers from technological experimentation).

107. *Id.* at 366–71.

108. *Id.* at 376–78.

109. *Id.* at 342.

110. *Id.* at 406–08.

111. *Id.* at 405.

has had sufficient incentives to implement."[112] In order to reduce the possibility of government giving exclusive rights to implementers of business models who do not need them, he suggests utilizing term competitions, in which the government would grant exclusive rights to the company willing to accept the shortest term,[113] or a bonding mechanism—for instance, requiring a company complaining of "free-riding" to prove they need an exclusive right by putting up a bond "to back up the applicant's claim that the business model will *not* be attempted in the application period requested if the application is refused. Others would then have the option of putting up a sum of money as a bond to back up the opposite claim."[114] In short, Abramowicz suggests, through careful design, government could create an efficient IP-based system for correcting undercommercialization of risky business models without creating the usual deadweight of IPR and of existing methods of rewarding commercial risk-like business method patents.[115]

2. COMMERCIALIZATION PATENTS

In *Commercializing Patents*, Sichelman builds on the commercialization theories discussed in Part I and on Abramowicz and Duffy's arguments about free riding on market experimentation. But he applies them to a slightly different problem: the low level of commercialization of patentable technological inventions and the difficulties faced by independent inventors and entrepreneurs seeking to commercialize.[116]

Like Kitch, Sichelman starts with the premise that "invention-centric" models of the patent system are incomplete because they fail to take into account the key role of patents in promoting commercialization.[117] But unlike Kitch, Sichelman argues that this narrow focus is one reason so few patents are actually commercialized. Noting that "[a]bout half, probably more" of all patented inventions are

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112. Michael Abramowicz, *Orphan Business Models: Toward a New Form of Intellectual Property*, 124 HARV. L. REV. 1362, 1365 (2011).

113. *Id.* at 1396.

114. *Id.* at 1370.

115. *Id.* at 1373 (noting that in the current system "[s]ome business models that receive patent protection might well be implemented by entrepreneurs even absent patent protection; in that case, patent protection is unnecessary and will lead to high prices and deadweight loss").

116. Sichelman, *supra* note 4, at 341 (noting that many U.S. patents are never commercialized).

117. *Id.* at 354 (arguing that the dominant reward theory of patent law is too "'invention-centric'" and "fails to take proper account of the supernormal risks and costs of unpatentable post-invention commercialization efforts").

never commercialized, Sichelman argues the reason is not that these inventions lack value.[118] Rather, several factors might lead inventors and their financial backers to demand higher returns than patents alone provide, including the risk of competitive free riding on unpatented information and the high transaction costs associated with obtaining licenses to use existing IPR.[119]

As a solution, Sichelman does not suggest broadening invention patents or offering them earlier in the innovation process. Instead, he proposes introducing a legal innovation without a direct, historic precedent in U.S. patent law:[120] a separate form of "commercialization patent" administered by the Patent Office alongside invention patents.[121]

In Sichelman's rendition, commercialization patents would have four distinctive features. First, commercialization patents could be obtained for "substantially novel" products of "the same types . . . as those within the scope of traditionally patentable subject matter" that have been claimed and disclosed under similar rules as are typically employed for invention patents.[122] Notably, unlike Abramowicz and Duffy's proposals, Sichelman's commercialization patents would be limited to traditional technological subject matter and could not be obtained merely for "commercially nonobvious" innovations such as the Ethiopian restaurant.[123] Second, commercialization patents would have shorter-term lengths than regular patents.[124] Third, they would trigger an affirmative duty to commercialize within that time (i.e., a working requirement).[125] Fourth, if one or more invention patents related to the product have previously been patented, a commercialization patent could

118. *Id.* at 343.

119. *See id.* at 354 (contending that just as invention "produces information subject to free riding, so does commercialization . . . [and that] the risks of *commercializing* inventions regularly demand supernormal returns to justify taking them").

120. *But see id.* at 396–400 (discussing existing and proposed options, such as petty patents and innovation warrants, that closely resemble commercialization patents).

121. *Id.* at 400, 403 (noting that the Patent Office would maintain an online commercialization patent database alongside the existing patent database).

122. *Id.* at 346, 400–04 ("Like patentable subject matter, the disclosure and claiming requirements should mostly track the existing requirements for invention patents, with a few important glosses.").

123. *Id.* at 400–01; *see also supra* notes 80 and 108 and accompanying text. Sichelman does not recommend extending patentable subject matter to include commercial nonobviousness but instead limits his proposal to the same types of subject matter that are currently patentable. *Id.* at 396–97 (suggesting that allowing patents for market innovations would require too much discretion by the Patent and Trademark Office to determine commercial nonobviousness).

124. *Id.* at 408–09.

125. *Id.* at 402 (stating that "there would be a working requirement," with a time period of perhaps three years from filing in which to commercialize).

not be obtained until the invention patent(s) has gone uncommercialized for at least three years.[126] After that time, the commercialization patent would impart limited immunity from injunctive relief from suits by holders of invention patents.[127] Instead, the commercialization patent holder would have to pay a reasonable royalty fee of around one to two percent.[128]

B. Is There Market Failure Ex Post to Invention?

Before evaluating these proposals for commercialization patents, it is necessary to answer a threshold question: are there "market failures" warranting government intervention *after an invention has been generated and disclosed to the public*? If so, what are they? As discussed in the Introduction and Part I, commentators have objected to patent commercialization theory and "ex post justifications for IP" on the ground that they are unnecessary.[129] There are several reasons we might think this to be the case.

First, in the United States, many sources of private investment are available for commercializing comparatively high-risk ventures involving new technology, including banks, large corporations, VCs, and angel investors.[130] According to one view, this is enough. "[W]e don't normally need supracompetitive returns or the prospect of exclusivity just to encourage someone to take an existing invention to market."[131] If inventors fail to commercialize, this must be because their inventions lack technological or commercial merit, and investors appropriately ignored them.[132]

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126. *Id.* at 346.

127. *Id.* at 405 (stating that "the commercialization patent would provide complete immunity from injunctive relief from suits for patent infringement" and would require only a reasonable royalty as damages of around one to two percent).

128. *Id.*

129. Lemley, *Ex Ante Versus Ex Post Justifications*, *supra* note 11, at 130–32.

130. Ronald J. Gilson, *Engineering a Venture Capital Market: Lessons from the American Experience*, 55 STAN. L. REV. 1067, 1068 (2003) (noting that venture capital markets in the U.S. have been "a major force in commercializing cutting-edge science"); Darian M. Ibrahim, *Financing the Next Silicon Valley*, 87 WASH. U. L. REV. 717 (2010) (discussing private venture capital, state-sponsored venture capital, and angel investor groups).

131. Lemley, *The Myth of the Sole Inventor*, *supra* note 1, at 739 (citing F.A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519, 524 (1945)); *see also* Lemley, *Ex Ante Versus Ex Post Justifications*, *supra* note 11, at 135–36 (using paper clips example to make this point).

132. *See* Lemley, *Ex Ante Versus Ex Post Justifications*, *supra* note 11, at 135–36; Lemley, *The Myth of the Sole Inventor*, *supra* note 1, at 739 (citing Hayek, *supra* note 131, at 524)).

Second, invention patents are already quite broad, including not just patents on traditional technological subject matter but also business method patents and design patents.[133] Even if market failures exist that might warrant government action, IPR are not worth the cost. Along with the usual costs of deadweight loss and hindering innovation,[134] providing exclusive rights beyond invention removes "the discipline of a competitive market" for evaluating the commercial merit of protected inventions.[135] This leads to less efficient outcomes and less innovation than if companies were forced to develop and market inventions in open competition with one other.[136]

By this logic, new forms of IPR that extend into commercialization would indeed make very little sense. They would produce additional monopolization costs and market distortions without a reasonable justification. We might go on to conclude that commercialization patents are "strikingly anti-market" incentives that should not be adopted.[137]

However, to the extent Lemley suggests there is no market failure in commercialization that warrants government intervention, the next Section casts doubt on this conclusion.[138] According to Gregory Mankiw's popular economics textbook, the government's role should be limited to enforcing the rules and maintaining the institutions of a market economy, the most important of which is property rights.[139] But government can play a role in improving market outcomes when "the market on its own fails to produce an efficient allocation of resources."[140]

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133. *See State St. Bank & Trust Co. v. Signature Fin. Grp., Inc.*, 149 F.3d 1368, 1373 (Fed. Cir. 1998) (holding that an invention is eligible for protection so long as "it produces a useful, concrete and tangible result"). For examples of the view that patents are already overbroad, see BURK & LEMLEY, *supra* note 62, at 30–31; Mark A. Lemley, *Software Patents and the Return of Functional Claiming*, 2013 WIS. L. REV. 905, 906–08 ("It is broad functional claiming of software inventions that is arguably responsible for most of the well-recognized problems with software patents."); *see also* Peter Lee & Madhavi Sunder, *Design Patents: Law Without Design*, 17 STAN. TECH. L. REV. 277, 291 (2013) (discussing justifications for design patents, including "incentives to develop new designs and consumer experiences").

134. Lemley, *supra* note 33, at 1058–65 (listing costs of IPR).

135. Lemley, *Ex Ante Versus Ex Post Justifications*, *supra* note 11, at 149.

136. *Id.* ("[W]e give up the very discipline that guarantees us the decisions will be the right ones.").

137. Lemley, *Ex Ante Versus Ex Post Justifications*, *supra* note 11, at 129.

138. *Id.* at 149 (arguing that IP should be only "a measured, limited response to market failure, [not] a way of transferring unlimited, perpetual power over products that have at least some market power into private hands"). To be fair, Lemley's main point is not necessarily that there is no market failure, but that IP is not worth the cost. *Id.* at 135–36; *see also* Lemley, *The Myth of the Sole Inventor*, *supra* note 1, at 740.

139. MANKIW, *supra* note 18, at 11–13.

140. *Id.* at 12–13.

The most oft-discussed market failures are externalities, public goods, market power, and information asymmetries.[141]

In the next Section, I draw on IP scholarship and literature on U.S. technology policy suggesting that several if not all of these types of market failures can potentially arise during commercialization of inventions. Accordingly, there is no inherent reason to reject commercialization patents on the ground that there is no market failure.

C. Identifying Commercialization Market Failures

The main reason these investors might forgo investing in a project that involves significant technological novelty is the comparably high level of risk and uncertainty involved in developing and marketing such innovations before anyone else has tried it.[142] The sources of this risk and uncertainty are numerous.[143] Below I limit discussion to the three major sources of risk that are theorized to warrant government intervention: commercialization spillovers, transaction costs related to IP licensing, and difficulties related to entrepreneurial financing.

1. FREE RIDING ON NEW COMMERCIAL INFORMATION

According to neoclassical economic theory, the market left on its own will allocate resources efficiently except in the case of market failure.[144] The most oft-discussed form of market failure in the patent and IP literature is caused by a positive externality: where one person's activity yields uncompensated benefits for others.[145] This can lead to a fear of free riding on the part of actors, who then forego producing the positive externality, to the ultimate detriment of society as a whole.

The main positive externalities of innovation are so-called "technology spillovers," defined as "the impact of one firm's research and production efforts on other firms' access to technological advance."[146] Technology spillovers can, at least for a time, be reduced significantly by granting narrow exclusive rights over new inventions

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141. *Id.* at 11–13 (noting oft-discussed market failures).

142. BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS, *supra* note 14, at 9 (discussing the crucial role of profit, risk, and uncertainty in private investors' motivations to invest in high technology ventures).

143. *See, e.g.*, Frischmann, *supra* note 1, at 363–64 (noting that "[t]he presence of risk leads to inefficient investment in innovation for a number of reasons").

144. MANKIW, *supra* note 18, at 11–12.

145. *Id.* at 199–202.

146. *Id.* at 201; *see also* BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS, *supra* note 14, at 139 n.1 (defining technology spillovers as where "other firms benefit from the investing firm's R&D effort").

that expire after a certain period.[147] But innovation also produces positive externalities that have little to do with classic "technological" experimentation. Rather, as Abramowicz and Duffy point out,[148] innovation can also produce "market spillovers" —where "new products stimulate creative dislocations in existing markets" that benefit their competitors and may lead to foregone investment.[149]

Distinguishing technology spillovers from market spillovers is difficult.[150] But a loose division can be drawn between information about how an innovation works (e.g., how to make a product, the best mode of practicing it, or the characteristics that distinguish it from prior art) and information about how the market will respond to the innovation once it is made available for purchase.[151] We could potentially broaden the concern still further by noting that "any activity following the initial invention," including "developing, testing, manufacturing, sales, and service of the initial invention" will produce "information subject to free-riding" that might hinder commercialization of *both* potentially patentable inventions that produce commercial information *and* purely market innovations not amenable to patents at all.[152]

Whether the risk of market spillovers is sufficient to warrant new forms of protection can be debated and indeed has been debated in the history of American patent law. Alexander Hamilton, for instance, advocated "patents of introduction" as a way to induce foreign entrepreneurs to establish their known inventions in the United States;

147. MANKIW, *supra* note 18, at 202 (suggesting patent protection is a better way than "industrial policy" to "deal with technology spillovers" by "giving [inventors] exclusive rights of their inventions for a period of time"). *But see* Wagner, *supra* note 78, at 995–99 (arguing that significant amounts of information will spill over despite the presence of patents for inventions).

148. Abramowicz & Duffy, *supra* note 5, at 346–47 (observing that "free-market economists have often confronted the problem that market experimenters may not be able to appropriate a fraction of the gains from their experimentation sufficient to justify the expense and risk of the experiment in the first place").

149. *See* BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS, *supra* note 14, at 139 n.1; *see also* Frischmann, *supra* note 1, at 363 (noting that "[a]ppropriation risks arise from exclusionary difficulties associated with the public goods nature of innovation and from market response risks").

150. BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS, *supra* note 14, at 170–71 ("[S]eparating the task of reducing technical risks from the problem of market definition is difficult," using the example of "'alpha tests'" of products involving new technology to determine consumer demand that lead to produce tweeking.).

151. *See, e.g.*, *id.* at 171; Abramowicz & Duffy, *supra* note 5, at 339 n.4 (distinguishing technological experimentation from market experimentation, the "commercial test of a product or service that is new to the market in which it is launched and that has uncertain prospects for commercial success").

152. Sichelman, *supra* note 4, at 354.

his proposals were rejected.[153] As mentioned above, scholars like Lemley adopt the opposing viewpoint that IP for commercialization would so deeply interfere with market competition that it cannot be justified as a "measured" response to market failure.[154]

Be that as it may, the point is simply that, once we take a broader view of the informational spillovers associated with bringing inventions to market, it is apparent that far more information is produced than is currently protected by patents. The difficulty of appropriating returns should increase the risk of investment, reduce the expectation of profit, and reduce the quantity of innovation produced. Whether this is sufficiently below the "socially optimal" level to warrant government intervention in the form of new IPR or some other form of incentive, and what the effects of such an intervention would be, is up for debate and evidentiary examination.[155]

2. TRANSACTION COSTS IN IPR LICENSING

As just explained, the main justification for new patents to promote commercialization of inventions is that current IP regimes do not provide would-be commercializers with enough protection from free riding during commercialization.[156] However, as emphasized by scholars like Suzanne Scotchmer, creating incentives for innovation is a two-sided enterprise: when IP regimes reward creators by allowing them to internalize spillovers, this can limit incentives for "cumulative" innovation[157] and "productive re-uses" of information by others.[158] This has implications for commercialization theory as well. Although the

153. *See* Camilla A. Hrdy, *State Patent Laws in the Age of Laissez Faire*, 28 BERKELEY TECH. L.J. 45, 56, 75 (2013) (discussing ALEXANDER HAMILTON, REPORT ON MANUFACTURERS (1791) and Edward Walterscheid, *Patents and Manufacturing in the Early Republic*, 80 J. PAT. & TRADEMARK OFF. SOC'Y 855, 860–78 (1998)).

154. *See* Lemley, *Ex Ante Versus Ex Post Justifications*, *supra* note 11, at 149.

155. *See, e.g.*, Frischmann & McKenna, *supra* note 40 (noting a "persistent ambiguity in IP scholarship about the normative baseline" and asserting that "many existing comparative institutional analyses are either silent on the underlying basis for comparison or depend on incredibly abstract and ambiguous normative baselines, such *Progress or optimal innovation*."); Ouellette, *supra* note 39, at 6–8 (noting significant empirical uncertainty about the benefits and costs of patents, the diverse sources of existing empirical evidence, "and the difficulty of reaching a clear answer on [the extent to which patents promote innovation]").

156. Sichelman, *supra* note 4, at 373–74 (discussing the need for IP to protect information generated during the postinvention commercialization phase due to the problem of free riding on first movers in commercialization).

157. Scotchmer, *supra* note 20, at 30–31.

158. Frischmann & Lemley, *supra* note 43, at 257–58 (emphasizing that over containment of innovation spillovers can be detrimental because innovation is conducive to "productive re-use[s]").

potential for widespread technology spillovers and market spillovers are certainly reasons to forego investing in commercializing inventions, too much IPR can hinder commercialization if it creates barriers for later commercializers who do not own the IPR they need to follow through.[159] Thus, "over-rewarding IPR regimes" can be described as a source of market failure that potentially justifies intervention in markets.[160]

The best policy may be to do nothing. According to the Coase theorem, the government's initial allocation of IPR does not matter when transaction costs are low.[161] If this is the case, then patent holders and commercializers should be able to reach licensing agreements that lead to the most efficient allocation of rights.[162] However, patent scholars such as Merges have highlighted the significant potential for transaction costs in IPR licensing, perhaps more than in real property contexts.[163] These include the difficulty of determining ownership and boundaries of IPR, difficulty in valuing inventions that have not yet been sold in markets, and disagreements among parties regarding the value of a patented

159. Abramowicz & Duffy, *supra* note 5, at 403 (noting that in cases which a defendant that has infringed an unworked invention patent "engaged in successful commercialization of a patented product without having the patent's protections against second movers, the patent cannot be defended as necessary . . . to encourage investment in commercialization"); Sichelman, *supra* note 4, at 384–85 (discussing inventor-commercializer transaction costs).

160. BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS, *supra* note 14, at 156 n.1 (noting that another form of innovation market failure is "intellectual property rights . . . regimes that either reward innovating firms inadequately (undermining incentives to undertake innovative projects in the short term) or excessively (stifling innovation in subsequent product 'generations')"). A distinct problem of IPR regimes that over reward creators, which Branscomb also notes, is that they can lead to *over investment in innovation*, whether by patent holders or by subsequent innovators. This is not desirable either, potentially leading to wasteful duplication of effort and investment in new products and services that add little to no value. *See id.* at 156 n.2 (citing empirical work); Yoram Barzel, *Optimal Timing of Innovations*, 50 REV. ECON. & STAT. 348, 352 n.10, 354 (1968) (asserting that competition between potential innovators for priority of invention may make the amount of resources devoted to innovating activity too large, and suggesting that patents, because they "legally deprive late innovations of their economic value," could exacerbate this problem.)

161. R. H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 15–19 (1960).

162. *See id.* at 15 (arguing that, assuming there are no costs involved in carrying out market transactions, a rearrangement of legal rights through the market will lead to an increase in productivity); *see also* MANKIW, *supra* note 18, at 210–12.

163. Robert P. Merges, *Of Property Rules, Coase, and Intellectual Property*, 94 COLUM. L. REV. 2655, 2655–60 (1994) (applying the Coase theorem—the idea that under low transaction costs conditions private parties can bargain over allocation of resources to solve externalities—to IP transactions and discussing various transaction costs that may prevent efficient bargaining over IP rights).

invention as opposed to later developments.[164] Additionally, scholars such as Michael Heller have emphasized theoretical difficulties in obtaining rights to practice innovations that trigger multiple overlapping patents (patent thickets),[165] and Lemley and Carl Shapiro have discussed the risk of "patent holdups," where a patent holder uses the threat of injunction to charge excessive licensing fees for a patent that is an "essential" input for implementing a product standard (i.e., standard essential patents or SEPs).[166] When transaction costs are high, private bargaining may break down, potentially warranting intervention through the court system or legislation.[167]

3. TRUST AND INFORMATION ASYMMETRIES IN ENTREPRENEURIAL FINANCING

Supporting entrepreneurs[168] is a goal of U.S. technology policy.[169] Entrepreneurs are believed to be particularly innovative and an important

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164. *Id.* at 2655; *see also* Richard A. Posner, *Intellectual Property: The Law and Economics Approach*, 19 J. ECON. PERSP. 57 (2005) (discussing transaction costs in IP licensing including holdouts and limited information regarding ownership).

165. *See* Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. 698, 700 (1998) (discussing the problem of transaction costs when multiple patents are required to practice a single innovation). *But see* Kirti Gupta, *The Patent Policy Debate in the High-Tech World*, 9 J. COMPETITION L. & ECON. 827 (2013) (debating the existence of thickets and holdups in the real world).

166. *See* Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991 (2007) (arguing that holdup problems arise when a patent holder who owns the patent to a minor aspect of a product attempts to extract inordinately high royalties using the threat of injunction); s*ee also* Ben Depoorter, *Property Rules, Liability Rules and Patent Market Failure*, 1 ERASMUS L. REV. 60, 67–71 (2008) (discussing the effects of innovation uncertainty and uncertain patent boundaries on patent licensing). *But see, e.g.*, Einer Elhauge, *Do Patent Holdup and Royalty Stacking Lead to Systematically Excessive Royalties?*, 4 J. COMP. L. & ECON. 535, 537 (2008) (arguing that the Lemley and Shapiro model understates the optimal royalty rate and overstates the predicted royalties from the threat of injunction); Gupta, *supra* note 165, at 842–44 (disputing the existence and prevalence of holdups).

167. *See eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388, 396–97 (2006) (Kennedy, J., concurring) (holding that courts should not automatically grant injunctions but should apply the usual four-factor equitable test for determining whether an injunction is warranted). On the relatively infrequent use of compulsory licensing in U.S. patent law, see Richard A. Epstein & F. Scott Kieff, *Questioning the Frequency and Wisdom of Compulsory Licensing for Pharmaceutical Patents*, 78 U. CHI. L. REV. 71, 85–92 (2011).

168. Again, I use the term entrepreneur to mean independent inventors, start-ups, early-stage companies, and small businesses without a significant track record. *See* Graham et al., *supra* note 13, at 1266–67.

169. On the White House's stated support for start-ups and entrepreneurs, see *Startup America*, WHITE HOUSE, http://www.whitehouse.gov/economy/business/

source of long-term economic growth.[170] In addition to innovating at higher rates, once entrepreneurs gain experience and training, they provide a valuable source of talent to go toward future projects (i.e., human capital).[171] This leads to more long-term innovation overall and may also produce immediate economic benefits for communities in which innovation occurs, such as hiring of local workers, wage increases, and localized knowledge sharing.[172]

Yet several market failures are specifically associated with high technology entrepreneurship that may make it appropriate for government to respond with incentives to bridge the gap between private and social returns. The first potential source of market failure to mention, though not to dwell on, is market power.[173] Independent inventors and start-ups lack market power as compared to established incumbents. As a result, they will not have the market advantages, such as networks, tax benefits, capital stores, and easy access to credit, that established

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startup-america (last visited Feb. 2, 2015); *see also* Gouvin, *supra* note 13, at 27–30, 45 (citing references demonstrating "the romantic notion of" the entrepreneur in U.S. political and popular culture but going on to demonstrate that politicians sometimes conflate support for entrepreneurs with support for small business generally).

170. As Eric Gouvin puts it, we might think of entrepreneurs as the engine of Joseph Schumpter's creative destruction, "whose activities disrupt[] the status quo." Gouvin, *supra* note 13, at 31. For a discussion of economic impacts of entrepreneurs and small businesses generally, see *id.* at 30–35. *See also* ALBERT N. LINK & JOHN T. SCOTT, EMPLOYMENT GROWTH FROM THE SUPPORT OF INNOVATION IN SMALL FIRMS 1–9 (2012); Graham et al., *supra* note 13, at 1258 n.1; Sichelman & Graham, *supra* note 98, at 114 n.14 (citing various studies finding "that startup and early-stage firms are more innovative per research and development (R&D) dollar than large firms," and suggesting that "they may account for a disproportionately large share of U.S. productivity"); Ashish Arora et al., *The Acquisition and Commercialization of Invention in American Manufacturing: Incidence and Impact* 1 (Nat'l Bureau of Econ. Research, Working Paper No. 20264, 2014), *available at* http://www.nber.org/papers/w20264.pdf (finding based on a sample of 6000 manufacturing firms that firms frequently rely on outside sources such as technology specialists for inventions that lead to marketed innovations, and suggesting outside inputs increase their innovative output).

171. ORLY LOBEL, TALENT WANTS TO BE FREE: WHY WE SHOULD LEARN TO LOVE LEAKS, RAIDS, AND FREE RIDING 7 (2013) (concluding that laws and policies that restrict worker mobility and knowledge transfer among firms, such as patents and noncompetes, will ultimately be harmful for innovation-intensive industries).

172. *See* Graetz & Doud, *supra* note 45, at 358–59. On localized benefits, see, for example, Cable, *supra* note 22, at 222–25 (explaining justification given for city venture development funds).

173. Market power, defined as "the ability of a single actor (or small group of actors) to have a substantial influence on market prices," is considered a potential basis for government intervention in the market, for instance through antitrust law. MANKIW, *supra* note 18, at 13, 319–23. On possible forms of intervention such as antitrust or regulation, see *id.* at 319–23.

corporations enjoy.[174] As such, capital constraints are thought to be a problem that more significantly impacts new entrants and businesses without a significant track record.[175]

Yet innovation can be a long and expensive process, both in terms of money and in terms of time and opportunity cost.[176] Even once an invention is established, significant amounts of further research may be required to generate commercial applications sufficient to attract investors. This vulnerable phase is sometimes called "early stage technology development" (ESTD) and is defined as the period between invention and achievement of a business plan that suggests near-term profits or the opportunity to cash out through sale or public offering.[177] During ESTD and preprofit production and marketing, entrepreneurs are likely to be vulnerable to funding gaps, *even in the presence of invention patents*, that do not trouble larger, better established firms.

How should U.S innovation policy respond to assist entrepreneurs stuck in what some call the "Valley of Death"?[178] One option is to do nothing. As mentioned, VCs are seen as a major source of high-risk commercialization financing for entrepreneurs.[179] But there are various reasons private sources of high-risk funding may be out of reach. VC markets are cyclical, and firms are concentrated in certain regions and in certain technology clusters.[180] Angel investors, which are present

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174. Graham et al., *supra* note 13, at 1259 (noting that since "early-stage companies tend to lack the kinds of complimentary assets (such as well-defined marketing channels, manufacturing capabilities, and access to cheap credit) that ease entry into the market, they are arguably even more sensitive to IP rights than their more mature counterparts").

175. *See* Lerner, *The Government as Venture Capitalist*, *supra* note 37, at 285–90 (reviewing the growing body of writing suggesting that new firms, especially technology-intensive ones, may be receiving insufficient capital).

176. *See* Merges, *supra* note 1, at 843 (discussing Schumpeterian perspective).

177. BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION, *supra* note 14, at 1, 33 (providing a five-stage model for the process of innovation, from basic research, to ESTD, to marketing and production, and discussing the need for government interventions during ESTD in particular); BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS, *supra* note 14, at 8–29 (same).

178. BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION, *supra* note 14, at 35–38 (noting that policy makers dramatize the risk of undercapitalization with oral and visual depictions of the "Valley of Death," but arguing that a more complex picture, representing all potential sources of funding rather than a "barren" territory, is more appropriate).

179. *See supra* note 130 and accompanying text.

180. Ibrahim, *supra* note 130, at 746–47 (geographic limits of VCs); Terrance P. McGuire, Note, *A Blueprint for Growth or a Recipe for Disaster? State Sponsored Venture Capital Funds for High Technology Ventures*, 7 HARV. J.L. & TECH. 419, 423–25 (1994) (contractions in VC markets). On the regional dimension of innovation and technology specialization in Silicon Valley, see ANNALEE SAXENIAN, REGIONAL

everywhere and may be more accessible to entrepreneurs without connections, are an important supplement.[181] Crowdfunding models may make these informal channels for raising risk capital even more significant, though it is still unclear how heavily regulated these channels will be.[182]

However, many have observed that pronounced information and trust asymmetries in technology financing may mean that entrepreneurs have trouble raising money *even if the right investor is located next door*.[183] In two recent books, Robert Cooter observes that "innovation poses a problem of trust between innovators with ideas and financiers capital," which he calls the "double trust dilemma."[184] The double trust dilemma has two sides.[185] The first side is seen from the perspective of inventors and entrepreneurs seeking funding; because they worry their ideas will be copied without compensation, they are reluctant to share them with putative financiers.[186] This results in an information gap that

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ADVANTAGE: CULTURE AND COMPETITION IN SILICON VALLEY AND ROUTE 128, at 122–31 (1996).

181. *See* Ibrahim, *supra* note 130, at 720–21 (highlighting the importance of angels and angel investor groups in financing innovation clusters like Silicon Valley).

182. Edmund W. Kitch, *Crowdfunding and an Innovator's Access to Capital*, 21 GEO. MASON L. REV. 887, 889–94 (2014); Sean M. O'Connor, *Crowdfunding's Impact on Start-Up IP Strategy*, 21 GEO. MASON L. REV. 895, 912–13 (2014); *see also* Camilla Alexandra Hrdy, *Kitch & O'Connor: Should Crowdfunding Be Regulation?*, WRITTEN DESCRIPTION (Sept. 14, 2014, 10:51 AM), http://writtendescription.blogspot.com/2013/09/kitch-oconnor-should-crowdfunding-be.html (summarizing Kitch's and O'Connor's articles).

183. *See, e.g.*, Gilson, *supra* note 130, at 1076–77 ("investing in early stage, high technology companies presents these problems [of uncertainty, information asymmetry, and agency cost] in an extreme form"); *see also* Burstein, *supra* note 1, at 242 (discussing Cooter's double trust dilemma and the disclosure paradox generally); Hemel & Ouellette, *supra* note 31, at 335 (discussing the risk that investors will take advantage of inventors, as well as the risk that innovators will use investors' money to develop on their own and cut investors out of the profits).

184. ROBERT D. COOTER & HANS-BERND SCHÄFER, SOLOMON'S KNOT: HOW LAW CAN END THE POVERTY OF NATIONS 6, 223 (2012) [hereinafter COOTER & SCHÄFER, SOLOMON'S KNOT]; *see also* ROBERT COOTER, THE FALCON'S GYRE: LEGAL FOUNDATIONS OF ECONOMIC INNOVATION AND GROWTH, at ix (version 1.4 2014) [hereinafter COOTER, THE FALCON'S GYRE] ("The 'double trust dilemma' refers to the problem of inducing the innovator to trust the investor with his ideas, and also inducing the investor to trust the innovator with her money.").

185. COOTER, THE FALCON'S GYRE, *supra* note 184, at ix.

186. COOTER & SCHÄFER, SOLOMON'S KNOT, *supra* note 184, at 27. This difficulty is often discussed with reference to the Arrow Information Paradox: "there is a fundamental paradox in the determination of demand for information; its value for the purchaser is not known until he has the information, but then he has in effect acquired it without cost." Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 615 (1962).

can prevent deals from moving forward.[187] The second side of the double trust dilemma arises from the perspective of investors.[188] To varying degrees, they may distrust both the ability and intentions of those seeking to spend their money while promising profits.[189] They may see a risk of shirking by entrepreneurs once the money is in hand[190] or fear that the deck will be stacked in management's favor, for instance by paying excessive salaries or spending too much on equipment (i.e., agency costs).[191]

Information asymmetries and agency costs can hinder any entrepreneurial venture, like a bakery or a knitting shop, but they are thought to be particularly pronounced in high-tech investing due to intense fear of copying and the difficulty of explaining science to investors.[192] As a result, even when an objective analysis would show a new technology has a high chance of being profitable in the relatively near future, investors and inventors may be unable to reach a deal. The lost societal benefits of the foregone investment, including near-term economic benefits and long-term benefits as a result of the production of new information, could, in theory, justify some form of government intervention to capture the spillovers.[193]

III. COMMERCIALIZATION AWARDS

Concluding a commercialization market failure exists and warrants government action is difficult as an empirical and practical matter. It requires determining both the "socially optimum level" of commercialization and whether a government incentive, whether patent or award, will get us closer to this benchmark. Obviously, reasonable people can disagree. But as I show below, externalities, transaction costs, and information asymmetries are already cited in government policy as justifying commercialization incentives—they just are not

187. *See, e.g.*, Hemel & Ouelette, *supra* note 31, at 336. This information asymmetry is obviously related to the appropriation risk associated with the nonexcludability of information, but it is distinct from the lack of financing for nonappropriable innovations. *See id.* at 334–36.

188. COOTER & SCHÄFER, SOLOMON'S KNOT, *supra* note 184, at 27.

189. *See id.*

190. *See* Kapczynski, *supra* note 31, at 986 ("Because ex ante contracts pay for effort rather than for results, the possibility of shirking also arises. Thus, one parameter that influences the efficiency of government contracting is the observability of effort.").

191. On agency costs in venture capital investing, see Gilson, *supra* note 130, at 1076–77.

192. *See, e.g.*, BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS, *supra* note 14, at 12 (describing the information and trust gap that exists between technologists on one side and investors/managers on the other).

193. Graetz & Doud, *supra* note 45, at 348–50.

commercialization *patents*. For better or worse, the United States already has a system of commercialization incentives to confront the market failures discussed above: direct financing for commercialization of science and technology-based research in the form of grants, loans, and equity, often called commercialization awards.[194] As I explain below, awards are available at both the federal and the local levels for small businesses and entrepreneurs in high technology fields based on an explicit policy of "closing the gap" between invention and innovation. Although several of these programs are the target of claims of government "activism" and "industrial policy,"[195] in Part III.C, I discuss a variety of evidence and my own case study suggesting that, if the goal is to help entrepreneurs commercialize inventions that they could not otherwise bring to market, awards are reasonably effective commercialization incentives.

A. A Descriptive Account of U.S. Commercialization Awards

1. FEDERAL AWARDS

At the federal level, large research agencies like the Department of Defense (DOD), the Department of Energy (DOE), and the Department of Health and Human Services (HHS), are required to offer Small Business Innovation Research (SBIR) awards for small businesses (under 500 employees) that are developing inventions with commercial potential that fall into the agencies' research areas[196] and similar Small Technology Transfer Research (STTR) awards for small businesses that partner with research institutions.[197] Although each SBIR-granting agency controls its own solicitations, awards must be administered in three phases.[198] Phase I awards, up to "$150,000 total costs for 6 months,"[199] are granted based on "the scientific and technical merit and feasibility of ideas that appear to have commercial potential."[200] Phase II

194. *See, e.g.*, BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION, *supra* note 14, at 1–4 (describing a perceived need for federal and state government funding sources during ESTD).

195. *See, e.g.*, Lewis M. Branscomb, *The National Technology Policy Debate*, *in* EMPOWERING TECHNOLOGY 26–27 (Branscomb ed., 1993) (discussing the lack of consensus on the role of technology policy).

196. 15 U.S.C. § 638(e)(4) (2012).

197. *Id.* § 638(e)(6). Unless otherwise noted, when I discuss SBIR I am also discussing STTR.

198. *Id.* § 638(e)(4).

199. *SBIR*, SBIR/STTR, http://www.sbir.gov/about/about-sbir (last visited Feb. 14, 2015).

200. § 638(e)(4)(A) (SBIR); *see also id.* § 638(e)(6)(A) (STTR).

awards, up to "$1,000,000 total costs for 2 years,"[201] are granted based on the small business's "record of successfully commercializing SBIR or other research" and success in obtaining funding commitments from non-SBIR sources.[202] Phase III awards entail further interaction with the agency but come with no further government funding.[203] SBIR agencies are required to monitor various metrics of commercialization success, including number of employees, revenue, and other sources of funding obtained.[204] In theory, an awardee's failure to meet a "minimum commercialization rate" should result in losing either funding or the opportunity to apply in the future.[205]

2. STATE AWARDS

States have long used public money to supply financing for entrepreneurs seeking to start new businesses.[206] In the past 20 years, states have increasingly begun to offer financing specifically for businesses attempting to commercialize technology and science-based ventures in their jurisdictions.[207] State commercialization awards tend to

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201. *SBIR*, *supra* note 199 (last visited Feb. 14, 2015).

202. § 638 (e)(4)(B) (SBIR); *see also id.* § 638 (e)(6)(B) (STTR).

203. *Id.* § 638 (e)(4)(C) (SBIR), (e)(6)(C) (STTR). Phase III does not generally involve any funding from SBIR/STTR; small businesses that apply for this phase have to obtain non-SBIR/STTR sources, including the federal government in a procurement relationship. *Id.*

204. *Id.* § 638(i) (annual reporting to SBA), (k)(2) (required government database), (k)(3) (updating required in Phase II); *see also id.* § 638(qq)(1)(A) (requiring each agency to establish a "system and to measure . . . success" and a "minimum performance standard").

205. *Id.* § 638(qq)(1)(B). However, as emphasized in a 2006 report by the Government Accountability Office (GAO), agencies do not strictly enforce commercialization requirements and face significant practical challenges in doing so. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-07-38, SMALL BUSINESS INNOVATION RESEARCH: AGENCIES NEED TO STRENGTHEN EFFORTS TO IMPROVE THE COMPLETENESS, CONSISTENCY, AND ACCURACY OF AWARDS DATA 17–18 (2006). It can take years before companies achieve commercial success. *Id.* at 17. "During this time, companies may move, change names, start a new business, or be purchased by other firms, all of which make it difficult for the agencies to track and link companies to the original SBIR awards." *Id.*

206. *See* PETER K. EISENGER, THE RISE OF THE ENTREPRENEURIAL STATE: STATE AND LOCAL ECONOMIC DEVELOPMENT POLICY IN THE UNITED STATES 241–65 (1988).

207. For recent descriptive work on states' extensive involvement in U.S. technology policy, see MARYANN FELDMAN & LAUREN LANAHAN, *State Science Policy Experiments*, *in* THE CHANGING FRONTIER: RETHINKING SCIENCE AND INNOVATION POLICY (Adam B. Jaffe & Benjamin F. Jones eds., 2014) (noting that state expenditures on R&D programs at universities alone are now over $3 billion and describing states' increasing expenditures since 1980 on these and other initiatives). *See also* STATE SCI. & TECH. INST., TRENDS IN TECHNOLOGY-BASED ECONOMIC DEVELOPMENT: LOCAL, STATE AND FEDERAL ACTION IN 2012, at 7–9 (2012), *available at* http://ssti.org/sites/default/files/

be more flexible than federal awards, ranging in size from around $30,000 to $2 million in the form of cash, loans, or equity.[208] Many are derivatives of federal awards, available only for selected winners of SBIR awards.[209] For example, the Kentucky SBIR Matching Funds Program, allegedly the first of its kind, matches up to $150,000 for Phase I awards and up to $500,000 for Phase II awards for award winners that are located in Kentucky.[210]

Others are fully state-funded awards for private enterprises developing a wide range of applied research, either independently or in partnership with universities. The stated goal of state commercialization awards is to "initiate" or "accelerate" commercialization of science and technology-based research, helping companies reach a stage at which they can obtain private investment.[211] To be eligible for state

trends2012.pdf (describing selected current state programs). For older descriptive work on state technology development programs, see DAN BERGLUND & CHRISTOPHER COBURN, PARTNERSHIPS: A COMPENDIUM OF STATE AND FEDERAL COOPERATIVE TECHNOLOGY PROGRAMS 26–28 (Christopher ed., 1995) (containing a comprehensive survey of state technology programs circa 1995). For legal scholarship reviewing state financing for high technology, see BRIAN KRUMM, *State Legislative Efforts to Improve Access to Venture Capital*, *in* ENTREPRENEURSHIP AND INNOVATION IN EVOLVING ECONOMIES: THE ROLE OF LAW (Megan M. Carpenter ed., 2012); McGuire, *supra* note 180 (providing an overview and detailed analysis of programs in, for example, Massachusetts and Michigan). *See also* Cable, *supra* note 22, at 202–04 (discussing city venture development funds).

208. *See, e.g.*, BERGLUND & COBURN, *supra* note 207, at 54; IND. ECON. DEV. CORP., 21ST CENTURY RESEARCH AND TECHNOLOGY FUND: EIGHTH REPORT TO THE INDIANA GENERAL ASSEMBLY 5 (2008–09); *Small Business Innovation Research (SBIR) Acceleration and Commercialization Program*, CONNECTICUT INNOVATIONS, http://www.ctinnovations.com/funding/sbir (last visited Feb. 26, 2015).

209. For a survey of state derivatives, see David M.G. Ross, *Leveraging Federal Programs to Boost Local Innovation and Encourage Venture Capital Investment: Considering the Small Business Innovation and Development Act and Derivative State-Level Incentives, with Specific Implications for Innovators and Legislators in Louisiana and the Southern States*, 11 TULANE J. TECH. & INTELL. PROP. 115, 123–24 (2008).

210. See Ky. Cabinet for Econ. Dev., *Kentucky First State to Match Federal SBIR-STTR Phase 1 and Phase 2 Grants*, EUREKALERT (Nov. 16, 2006), http://www.eurekalert.org/pub_releases/2006-11/kcfe-kfs111606.php ("The [Kentucky] program is the first in the United States to specifically match federal SBIR and STTR Phase 2 awards and is part of Kentucky's plan to offer its high-tech small businesses comprehensive SBIR and STTR funding."). For more information, see *Kentucky SBIR/STTR Matching Funds Program*, KENTUCKY SCI. & ENGINEERING FOUND., http://ksef.kstc.com/index.php/funding-programs/ky-sbirsttr-matching (last visited Feb. 14, 2015).

211. For example, Indiana's 21st Century Research and Technology Fund authorizes "Initiation Awards" of up to $500,000 for companies in the proof-of-principle stage and "Commercialization Awards" of up to $2 million "to accelerate product development and commercialization." IND. CODE ANN. § 5-28-16-2(a) (LexisNexis 2014); IND. ECON. DEV. CORP., *supra* note 208, at 5. Another example is Iowa's

commercialization awards requires undertaking a commitment to commercialize within a "reasonable period of time" and frequently requires locating all or some commercialization activities in the state.[212] Matching from nongovernment sources is also required, as discussed in the next Section.[213]

Awards are either managed within government agencies, as with SBIR and some state programs, or are contracted out to private investment firms operating in pursuance of government goals.[214] For example, in Oklahoma, where I conducted interviews, the legislature

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"Demonstration Fund," which is operated by the Iowa Economic Development Authority and authorizes loans, forgivable loans, and grants of up to $150,000 for "innovative businesses" in Iowa engaged in "high-technology prototype and concept development activities . . . *[with] a clear potential to lead to commercially viable products or services within a reasonable period of time*," in order to "help [them] . . . reach a position *where they are able to attract later stage private sector funding*." IOWA ADMIN. CODE r. 261-105.2(15) (2013) (emphasis added) (purpose); *id.* r. 261-105.4(15) (project based); *see also* IOWA CODE ANN. § 15.411.3 (West 2011). Iowa defines "[i]nnovative business" as "a business applying novel or original methods to the manufacture of a product or the delivery of a service." *Id.* § 15E.52(1)(c); *see also Demonstration Fund*, IOWA ECON. DEV., http://www.iowaeconomicdevelopment.com/Entrepreneurial/DemoFund (last visited Feb. 14, 2015). Iowa's "Acceleration Fund" provides additional financing for innovative businesses in their later stages or businesses that partner with state universities for "the development of innovative ideas and businesses." IOWA ADMIN. CODE r. 261-108.2(15); *see also id.* r. 105.6(15) (location in Iowa required).

212. *See, e.g.*, IOWA ADMIN. CODE r. 261-105.2(15), -105.6(15) (2013); OKLA. ADMIN. CODE § 650:10-1-1(1) (2014). Texas's Emerging Technology Fund provides "Commercialization Awards" in the form of equity investments for private or nonprofit enterprises working on developing "emerging technology projects with a demonstrable economic benefit to the state." TEX. GOV'T CODE § 490.001(4) (2013) (equity awards); *id.* § 490.151 (describing Incentives for Commercialization Activities). Texas Commercialization Award recipients must collaborate with a state research institution or private institution of education in the state and must "guarantee by contract that a substantial percentage of any new or expanded commercialization or manufacturing resulting from the award will be established in this state." *Id.* (eligibility limited to collaborations); *id.* § 490.155 (contractual guarantee of operation in Texas). For a description of commercialization awards on the governor's website, see *Texas Emerging Technology Fund - Commercialization Awards*, OFF. GOVERNOR, http://gov.texax.gov/ecodev/etf/etf_commercilization_awards (last visited Feb. 14, 2015).

213. *See infra* Part III.B.3.

214. For instance, since April 2011, Indiana's 21st Century Fund, described above, has been managed by Elevate Ventures, a nonprofit under contract with the Indiana Economic Development Corporation and the State of Indiana. *21 Fund and Elevate Ventures, Inc.*, INDIANA, http://iedc.in.gov/entrepreneurship/21-fund (last visited Feb. 14, 2015); *see also* IND. CODE ANN. § 5-28-16. Oklahoma's TCC is managed by a nonprofit called "i2E" ("investment to enterprise") in coordination with the Oklahoma Center for the Advancement of Science and Technology (OCAST), an instrumentality of the state. *Oklahoma Technology Commercialization Center (OTCC)*, OKLAHOMA CTR. ADVANCEMENT SCI. & TECH., http://www.ok.gov/ocast/Programs/Oklahoma_Technology_Commercialization_Center_%28OTCC%29/ (last modified Aug. 8, 2012); *see also* OKLA. STAT. ANN. tit. 74, § 5060.2.B (West 2014).

finances a complete Technology Commercialization Center (TCC).[215] The TCC provides project-based awards through the Applied Research Support Program (OARS) for Oklahoma-based enterprises, nonprofits, and educational institutions pursuing "applied research activities" whose results have "a high probability of leading to commercially successful products, processes or services within a reasonable period of time and a significant potential for stimulating economic growth within the State of Oklahoma."[216] Matching from private sources is required to receive OARS and other forms of Oklahoma funding.[217] OARS winners and other Oklahoma-based enterprises can also apply for a variety of financing programs like the Oklahoma Seed Capital Fund, which provides equity and convertible notes for Oklahoma-based high growth, technology-based start-ups, with awards ranging from around $100,000 to $1 million.[218]

B. Commercialization Award Features

Based on an analysis of SBIR and state awards, I identify several key features of commercialization awards.

1. MIXED REGULATORY OBJECTIVES

The main regulatory objective of a commercialization award is to provide credit for inventors, start-ups, and small businesses seeking to commercialize inventions but experiencing difficulties raising money,

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215. *Oklahoma Technology Commercialization Center*, *supra* note 214. For this project I travelled to Oklahoma City and visited the Technology Commercialization Center headquarters, run by a private nonprofit called "i2E." On December 20, 2013, I spent several hours interviewing Casey Harness, External Relations Coordinator, Director of the i2E Fellows Program, and Oklahoma Bioscience Association Liaison, in Oklahoma City, Oklahoma.

216. OKLA. STAT. ANN. tit. 74, § 5060.4.8 (definition of "enterprise"); OKLA. ADMIN. CODE § 650:10-1-1 (purpose); *id.* § 650:10-1-7 (eligibility). "Applied research" means research activities having "potential commercial application." OKLA. STAT. ANN. tit. 74, § 5060.4.3; *see also Oklahoma Applied Research Support (OARS)*, OKLAHOMA CTR. ADVANCEMENT SCI. & TECH., http://www.ok.gov/ocast/Programs/Oklahoma_Applied_Research_Support_(OARS)/ (last modified July 10, 2014).

217. OKLA. STAT. ANN. tit. 74, § 5060.20a ("a recipient shall be required to obtain separate private investment or funding"); *see also, e.g.*, OKLA. ADMIN. CODE § 650:10-1-11(b)(1) (applied research program requires 50 percent matching). Some basic research programs do not require matching. *E.g.*, *id*. § 650:12-1-11(c) ("Oklahoma Plant Science Research basic research projects require no matching funds.").

218. *See* OKLA. STAT. ANN. tit. 74, § 5060.21 (authorizing the Seed-Capital Revolving Fund). I have write-ups of i2e's various fund profiles in my private files. For public information on these funds, see *Access to Capital*, INNOVATION TO ENTERPRISE, http://www.i2e.org/access-to-capital/ (last visited Feb. 14, 2015).

who require a small credit infusion in order to reach a stage at which private financing becomes feasible. Accordingly, to be eligible for an award, applicants must show that the government's participation is "instrumental" to the success of the enterprise[219] and undertake a commitment to commercialize within a "reasonable period of time."[220] A useful way to think of this is that government is attempting to mobilize the *marginal commercializer*: a developer of a new technology that cannot obtain sufficient financing to commercialize without government support but that *can* do so with government support.

Commercialization awards also have another regulatory objective: to pursue public goals not shared by the private sector. At the federal level, this means promoting commercialization of technologies that fall into core "mission areas," such as public health, national security, or technologies in emerging fields that government thinks will produce long-term social benefits, like nanotechnology, 3D printing, and "social innovation."[221] Importantly, another government mission is helping small businesses. This preference for smallness is codified in programs like small business loans and SBIR.[222]

At the local level, the public goals motivating awards have a different flavor. In granting commercialization awards, state governments seek to promote economic development directly in the region.[223] Expected benefits include near-term benefits from new technology start-ups and company relocation, such as tax revenues and hiring of skilled and unskilled workers.[224] Local governments also seek long-term efficiency gains that are thought to arise from agglomeration

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219. This language comes from the Oklahoma program, but I do not include the location requirement. *See* OKLA. STAT. ANN. tit. 74, § 5060.21.F(2)(c)–(d) (stating that to provide financing from the fund, OCAST must find, among other things, that OCAST's "participation is instrumental to the success of the enterprise and will assist in its retention within the state," and that OCAST's "investment is leveraged by at least one additional equity or near-equity investor").

220. This language comes from various statutes and administrative codes. *See, e.g.*, IOWA ADMIN. CODE § 261-105.2 (15) (2013).

221. *See* Branscomb, *supra* note 195, at 8–9, 14, 19; Lewis M. Branscomb & George Parker, *Funding Civilian Dual-Use Industrial Technology*, *in* EMPOWERING TECHNOLOGY 64–66, 68–69, 71, 77, 97–98; Kelley, *supra* note 26, at 315–18; Peter Lee, *Social Innovation*, 92 WASH. U. L. REV. (forthcoming 2015), *available at* http://openscholarship.wustl.edu/law_lawreview/vol92/iss1/5 (discussing financing mechanisms for social innovations that are not always supported either by patents or commercial markets).

222. *See* BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS, *supra* note 14, at 144, 149–50 (noting that supporting small businesses is an exception to the federal government's hesitance to assist individual firms).

223. *See* Zhao & Ziedonis, *supra* note 37, at 4–5 (discussing the goals of state technology financing).

224. *Id.* at 5; *see also* McGuire, *supra* note 180, at 419–22.

economies. These include lower transportation costs, larger market sizes, and localized knowledge spillovers, all of which are believed to result when businesses locate close to other businesses in related industries.[225] This strategy is often discussed in connection with attempts to build "innovation clusters."[226]

2. RELATIVELY SMALL AWARDS CALIBRATED TO NEED

Commercialization awards can range in size from around $30,000 to $2 million in the form of cash, loans, or equity.[227] As explained above, SBIR awards are limited by statutory requirements.[228] But state awards are usually calibrated to the specific commercialization needs of the applicant, as determined from the application or fundraising pitch.[229]

3. MATCHING REQUIREMENTS

A very important feature of commercialization awards is that they increasingly require securing simultaneous financing from private sources.[230] This strategy is called "matching," or sometimes

225. *See* ENRICO MORETTI, THE NEW GEOGRAPHY OF JOBS 121–53 (2013) (reviewing evidence of positive effects of proximity on innovation); Cable, *supra* note 22, at 199–200, 212–25 (discussing agglomeration economies in the context of city venture development funds, noting that benefits include, for example, "the cultural attributes and lifestyle amenities that attract workers and entrepreneurs to a cluster location, and the tendency for valuable information (such as technical expertise) to spread throughout a cluster"); Daniel B. Rodriguez & David Schleicher, *The Location Market*, 19 GEO. MASON L. REV. 637, 641–45 (2012) (applying agglomeration theory to city location markets).

226. Michael E. Porter, *Clusters and the New Economics of Competition*, HARV. BUS. REV., Nov.–Dec. 1998, at 77, 83. For a summary of innovation cluster theory, see Thomas P. Lyon & Russell A. Baruffi, Jr., *Creating a Plug-In Electric Vehicle Industry Cluster in Michigan: Prospects and Policy Options*, 18 MICH. TELECOMM. & TECH. L. REV. 303, 305–09 (2011). On the organic evolution of Silicon Valley, see SAXENIAN, *supra* note 180, at 4, 9, 34. *See also* Camilla A. Hrdy, *Cluster Competition* (2015) (unpublished manuscript) (on file with author).

227. *See supra* note 208 and accompanying text.

228. *See supra* Part III.A.1.

229. *See, e.g.*, Reissue PHS 2013-02 Omnibus Solicitation of the NIH for Small Business Technology Transfer Grant Applications (Parent STTR [R41/R42]), *available at* http://grants.nih.gov/grants/guide/pa-files/PA-13-235.html (last visited Feb. 15, 2015) (NIH's 2013 omnibus SBIR solicitation notice); OFFICE OF THE GOVERNOR, TEX. EMERGING TECH. FUND, COMMERCIALIZATION AWARD (SUBCHAPTER D) FUND IV APPLICATION 6, *available at* http://gov.texas.gov/ecodev/etf/apply_commercialization (last visited Feb. 15, 2015) (Texas's Emerging Technology Fund (TETF) application requires itemizing all funding sought from the state, along with a "breakdown of other funding [the applicant is] seeking in parallel with the TETF award.").

230. For state examples, see IOWA ADMIN. CODE r. 261-105.5(15) (2013) ("In order to receive financial assistance, an applicant must demonstrate the ability to secure

"leveraging," to indicate that public money is being "combined with private funds to leverage the impact of the state's resources."[231] With strict matching requirements, the government might still do the first significant due diligence on an applicant to determine technical and commercial potential, but the government will not close a financing deal until equal co-investment from private sources is obtained.[232] Notably, matching can come from professional VC's, angels, and even crowdfunding, so long as there is an external, nongovernment investor.[233]

4. STAGED FINANCING

Awards are generally granted in multiple stages, with additional financial support depending on commercialization success and on additional success in generating private interest in the company.[234] Sometimes called "staged" or "tiered" financing, this allows government to mitigate risk by limiting the amount of public money spent until

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one dollar of nonstate moneys for every two dollars received from the authority."); OKLA. ADMIN. CODE § 650:10-1-11 (2014) (requiring at least 50 percent of direct project cost to be provided by sources other than the state). SBIR does not require matching in Phase I or II (but Phase III awards come with no government financing); instead it requires companies to obtain private investment to continue participating in the program. 15 U.S.C. § 638(e)(4) (2012) (SBIR); *see also id.* § 638 (e)(6) (STTR).

231. Ibrahim, *supra* note 130, at 737 (discussing matching); McGuire, *supra* note 180, at 429 (discussing leveraging).

232. For example, according to Mr. Harness, the Oklahoma Seed Capital Fund requires all investments to have one-to-one capital co-investment from VCs or angel investors before the state will close a deal, but i2E will sometimes do significant due diligence before the company has any investors. *See supra* notes 215–18 and accompanying text. SBIR's three-phase system also resembles this strategy. Government provides Phase I awards without co-investment, but by Phase III companies are expected to have secured private financing. 15 U.S.C. § 638(e)(4)(C), (e)(6)(C).

233. *See, e.g.*, Richard Waters, *Start-ups Seek the 'Wisdom of Crowds'*, FIN. TIMES (Apr. 3, 2012), http://www.ft.com/cms/s/0/c1f1695c-7da8-11e1-9adc-00144feab49a.html.

234. *See supra* Part III.A, III.B.3. SBIR awards come in three phases, the first two of which involve funding. *See supra* notes 198–203 and accompanying text. An example of a staged state award is Iowa's Acceleration Fund, which provides financing for Iowa-based companies or university researchers at three different stages of development: pre-seed stage (up to $100,000 or 50% of the project costs in low-interest loans or royalty agreements), seed stage (up to $300,000 or 50% of the total project cost in low-interest loans or royalty agreements), and expansion stage (where companies can receive a secured, low-interest loan of up to $500,000 or 50% of the total project cost). *Iowa Innovation Acceleration Fund*, IOWA ECON. DEV., http://www.iowaeconomicdevelopment.com/Entrepreneurial/SSBCIInnovation (last visited Feb. 15, 2015).

further success is apparent.[235] It also creates an additional performance incentive for the company.[236]

5. MONITORING COMMERCIALIZATION SUCCESS

Closely related, awards use various mechanisms for monitoring the commercialization success of recipients. As mentioned above, SBIR requires federal agencies to monitor commercialization success and publish information in public and private databases.[237] States monitor commercialization success through face-to-face meetings, postaward reporting requirements, and annual performance reviews.[238] Performance reviews, which may be performed by a state agency or a private company, typically include information such as awardees' identities, area of research, state investment amounts, annual revenues subsequent to the awards, and number of employees generated and the industries in which they are employed.[239]

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235. *See* Gilson, *supra* note 130, at 1073, 1078–81 (2003).

236. On VC's use of staged financing as a performance incentive, see Gilson, *supra* note 130, at 1079. *See also* Abramowicz, *supra* note 31, at 43 (noting that "it may be appropriate for rewards to be deferred until after there has been some time for commercialization").

237. *See* § 638(i) (requiring annual reporting to SBA); *id.* § 638(k) (requiring government database); *id.* § 638(qq)(1)(A) (requiring the agency to establish a "system to measure . . . success" and a "minimum performance standard").

238. For instance, Oklahoma's Applied Research Program requires award recipients to "maintain records and accounts that properly document and account for the source and application of all project funds" and to make all records available for inspection by OCAST. OKLA. ADMIN. CODE § 650:10-1-12(d) (2014). OCAST's guidelines require principal investigators that are funded under the program to submit annual progress reports at specified periods and emphasizes that "[f]ailure to submit the annual report as required may result in a gap in funding or loss of funds." OCAST, OKLAHOMA APPLIED RESEARCH SUPPORT (OARS) PROGRAM: PROGRESS REPORT / PERFORMANCE EVALUATION, INSTRUCTIONS TO PRINCIPAL INVESTIGATORS (version 2014-06-12), *available at* http://www.ok.gov/ocast/documents/OARS%20Progress%20Report%20Instructions%20to%20PI.pdf; *see also* IOWA ADMIN. CODE r. 261-105.10(3) (2013) ("An applicant shall submit any information required by the [Economic Development Authority] in sufficient detail to permit the authority to prepare any reports required by the authority, the board, the general assembly or the governor's office.").

239. *See, e.g.*, ECONSULT SOLUTIONS, THE ECONOMIC AND FISCAL IMPACT OF THE DEMONSTRATION FUND ON THE IOWA STATE ECONOMY (Feb. 20, 2013), *available at* https://governor.iowa.gov/wp-content/uploads/2013/04/Combined-Economic-and-Fiscal-Impact-Report-FINAL-2013-02-20-2.pdf; IND. ECON. DEV. CORP., *supra* note 208.

6. INVENTION PATENT OWNERSHIP

An important feature of commercialization awards from the perspective of invention patent commercialization theory is that they encourage obtaining patents for any new and nonobvious technological inventions involved in the business. Award administrators typically require itemizing all patents and IP that the company has obtained or plans to obtain.[240] Administrators may give extra weight to ownership of patents and other IP in making awards.[241] According to commercialization theory, this strategy increases the incentive to commercialize rapidly and also permits patent ownership to serve as a signal of commercial potential.[242]

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240. *See, e.g.*, IOWA ECON. DEV. AUTH., 2014 APPLICATION (FY2015) ENTREPRENEURIAL AND INNOVATION SUPPORT PROGRAMS 10 (Aug. 19, 2014), *available at* http://www.iowaeconomicdevelopment.com/userdocs/documents/ieda/Demofundapp 2013.doc; OFFICE OF THE GOVERNOR, TEX. EMERGING TECH. FUND, *supra* note 229, at 7; UNIV. OF S.C. INTELLECTUAL PROP. OFFICE, SBIR/STTR MANUAL FOR FACULTY, STAFF, AND STUDENTS 18–19 (2007), *available at* http://ip.research.sc.edu/PDF/ SBIR-STTRmanual.pdf. Federal agencies participating in SBIR also require identification of relevant IP in proposals. For instance, the National Institute for Standards and Technology (NIST) SBIR solicitations require that all IP be noted on a single page in the proposal and labeled as confidential and proprietary, while the National Institutes of Health (NIH) "give[] the applicant the option of listing the proprietary page numbers in a legend on the table of contents page, or highlighting the actual proprietary sections with asterisks." UNIV. OF S.C. INTELLECTUAL PROP. OFFICE, *supra*, at 18–19 (identifying a variety of ways in which different agencies require identification of IP in SBIR proposals); *see also, e.g.*, IOWA ECON. DEV. AUTH., *supra*, at 10 (asking whether the technology to be developed involves "patentable products/processes or [IP] that can be protected through copyright or other legal means[,]" and whether any patents have yet been filed, who owns the patents, and whether a valuation of the patent has been done); OFFICE OF THE GOVERNOR, TEX. EMERGING TECH. FUND, *supra* note 229, at 7 ("List any issued or pending IP including dates, numbers and descriptions, including patents, trademarks, copyrights and trade secrets.").

241. For example, according to an employee at i2E in Oklahoma, which has a contract to invest state money in high-tech enterprises that agree to locate in the state, although the state is "agnostic" regarding which type of technology the enterprise is developing, ownership of patents and IP, or an exclusive license to use others' IP, is very important in deciding whether to help a company with commercialization. Interview with Casey Harness, External Relations Coordinator, Directory of i2E Fellows Program, Oklahoma Bioscience Association Liaison, in Oklahoma City, Okla. (December 20, 2013).

242. *See* Kitch, *supra* note 1, at 276–77; *see also, e.g.*, Eisenberg, *supra* note 100, at 1663–65 (discussing the policy behind the Bayh Dole Act and the SBIR to use patents to push market transfer). On signal theory and debates, see also *infra* Part IV.A.1.

C. Measuring Commercialization Awards' Efficacy

As just explained, commercialization awards' main goal is to mobilize marginal commercializers: those who could not commercialize inventions without government support but can do so with government support. Their secondary goal is to promote a variety of public goals, including breakthroughs in public health, spurring job creation, and supporting small business.

So do commercialization awards actually work? There are some eye-popping numbers. For example, in his recent testimony before the House of Representatives in support of more funding for SBIR, Robert Schmidt of the Small Business Technology Council reported that over the last 32 years SBIR companies have been issued nearly 100,000 patents and have "produce[d] 25% of America's R&D 100 Awards."[243] Moreover, he reports, 7.8 percent of all SBIR companies have been involved in mergers and acquisitions, suggesting that they are commercially viable, and that they "play an outsize role in net job creation in the United States."[244] Similarly encouraging data has been released by the states. For instance, the TETF reports that between 2005 and 2012 Texas gave $195 million in commercialization awards to 137 companies, which then went on to raise over $750 million from nonstate sources, and that thousands of jobs were created by these investments.[245]

But of course what really matters is not whether commercialization awards are correlated with commercialization of inventions and job creation; it is whether they have resulted in *more or faster commercialization than would have occurred in a counter-factual world in which no government funding was available*. As I discuss below, a variety of evidence suggests that awards have indeed positively affected many of the companies that received them as compared to the alternative of no funding.[246]

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243. *See* SCHMIDT TESTIMONY, *supra* note 27, at 9.

244. *Id.*

245. *See* OFFICE OF THE GOVERNOR, ECON. DEV. & TOURISM, TEX. EMERGING TECH. FUND: FISCAL YEAR 2012 LEGISLATIVE REPORT 3, 19–22 (2012), *available at* http://gov.texas.gov/files/ecodev/etf/TETF_Report_FY2012.pdf. As discussed below, there are plenty of reasons to doubt these numbers, including accusations of corruption. *See The Fire of Corruption Rages in Rick Perry's Texas*, MALIA LITMAN'S BLOG (Oct. 10, 2011), http://malialitman.wordpress.com/2011/10/10/the-fire-of-corruption-rages-in-rick-perrys-texas/ (reporting news that challenges these numbers).

246. Importantly, this does not address the extent to which government's investments in commercialization awards are the most efficient way to resolve commercialization market failure. I address this issue in Part III.D when I compare commercialization awards to commercialization patents as responses to market failure.

1. EMPIRICAL STUDIES

Substantial empirical research has been done on the federal SBIR program and similar public funds for small businesses and start-ups in other countries like Israel.[247] A highly useful form of evidence is empirical studies that compare award winners to similarly situated companies that did not receive awards. Josh Lerner's study of SBIR awards suggests that they have had a positive impact on awardees' ability to grow as compared to similarly situated companies that did not get awards, especially when awardees were located in regions where they had access to private sources of capital.[248] Moreover, Lerner found evidence that the awards produced a "certification effect": awardees were more easily able to access capital from private investors due to the government's decision to select the venture for an award.[249] Not surprisingly, a National Bureau of Economic Research (NBER) study following up on Lerner's work suggests that ultimate commercialization success is correlated with obtaining private sector matching or internal matching from the company's own sources.[250] Commercialization success is also correlated with university involvement.[251]

Similar research has been done on state awards. In 2012, Bo Zhao and Rosemarie Ziedonis built on Lerner's study of SBIR awards, performing a similarly designed empirical study of a Michigan commercialization awards program.[252] They found a similar effect as Lerner: awards enhanced company survival as compared to similar prospects that did not get awards and apparently produced a certification effect that helped award recipients obtain additional financing from private sources.[253]

In 2002, Maryann Feldman and Maryellen Kelley used case studies to evaluate state programs designed to support technology-pioneering

247. *See, e.g.*, Lerner, *The Boulevard of Broken Dreams*, *in* INNOVATION POLICY AND THE ECONOMY, *supra* note 37, at 67, 70–72.

248. Lerner, *The Government as Venture Capitalist*, *supra* note 37, at 286–90.

249. *Id.* at 313–15 (assessing the impact of SBIR awards between 1983 and 1997 and finding that over a 10-year period awardees grew faster than a matched set of companies, though observing that positive impacts were mainly confined to areas with substantial venture capital presence).

250. *See* Albert N. Link & Christopher J. Ruhm, *Bringing Science to Market: Commercializing from NIH SBIR Awards* 21 (Nat'l Bureau of Econ. Research, Working Paper No. 14057, 2008), *available at* http://www.nber.org/papers/w14057.pdf.

251. *Id.* at 16.

252. *See* Zhao & Ziedonis, *supra* note 37, at 1.

253. *Id.* at 1–3 (analyzing economic effects of Michigan Life Sciences Corridor (MLSC) program launched in 1999).

start-ups.[254] Specifically, they tracked the progress of four winners of federal Advanced Technology Program (ATP)[255] awards that also received state funding (e.g., public venture funds or matching funds) and other support, such as help from university-based technology transfer programs or access to university facilities, to facilitate commercialization.[256] They concluded based on these cases that state awards, though small compared to federal research and development (R&D) grants or private venture capital, "appear[ed] to nurture [the] firms' development."[257]

2. CASE STUDY OF A COMMERCIALIZATION AWARD WINNER

This Section presents my own case study of a faculty entrepreneur at the Yale School of Medicine, whom I will refer to by the pseudonym "Bruce."[258] Although I do not argue that this case study represents a statistically significant average, it is helpful in illustrating how commercialization awards operate in practice and how they can potentially help companies developing new inventions survive into the commercialization stage when they might not have otherwise.[259]

Bruce is a research scientist in psychiatry at Yale. About 10 years ago, he developed a computer-based brain-training program for harnessing neuroplasticity and improving cognitive function, with

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254. Maryann P. Feldman & Maryellen R. Kelley, *How States Augment the Capabilities of Technology-Pioneering Start-Ups*, 33 GROWTH & CHANGE 173, 173 (2002).

255. ATP has since been abolished. *See* WENDY H. SCHACHT, CONG. RESEARCH SERV., 95-30, THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY: AN APPROPRIATIONS OVERVIEW 1–2 (2011).

256. Feldman & Kelley, *supra* note 254, at 175, 178–79.

257. *Id.* at 173; *see also* MARYANN FELDMAN & LAUREN LANAHAN, CTR. FOR AM. PROGRESS, SILOS OF SMALL BEER: A CASE STUDY OF THE EFFICACY OF FEDERAL INNOVATION PROGRAMS IN A KEY MIDWEST REGIONAL ECONOMY (2010), *available at* http://cdn.americanprogress.org/wp-content/uploads/issues/2010/09/pdf/small_beer.pdf (performing surveys of the CEOs of small- and medium-sized Midwestern companies and finding that state awards were perceived to be more accessible than federal awards, even though some entrepreneurs complained that they were still too small to meet their financing needs).

258. Interview with Bruce, Research Scientist, Yale Sch. of Med., in New Haven, Conn. (October 26, 2013). I had a follow-up interview with Bruce on July 14, 2014, in New Haven, Connecticut. Follow-up interview with Bruce, Research Scientist, Yale Sch. of Med., in New Haven, Conn. (July 14, 2014). Hereinafter the October 26, 2013, and the July 14, 2014, interviews will be collectively referred to as "Bruce Interviews."

259. On the utility of case studies for discussing the efficacy of innovation incentives such as patents, see Kristen Osenga, *Formerly Manufacturing Entities – Piercing the 'Patent Troll' Veil*, CONN. L. REV. (forthcoming 2014), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2476556.

potential uses for schizophrenia treatment. Yale declined to invest in the program. Bruce began consulting for a company in California, which obtained patents on the invention. However, the company decided to develop another product and shelved development of Bruce's schizophrenia program. He and another employee started their own company to develop their model.[260]

Once he got back to Yale, Bruce started work on a second-generation model with improved functionality and focused on applying his program to treatment of cognitive dysfunction in children. While there, he partnered with a Chinese colleague and formed a company in Connecticut. They revised the invention to include both a neuroplasticity-harnessing computer-based program and, innovatively, a physical exercise regime. Through Yale, they filed for patents on the new version.[261] Yale also helped to raise money from angel investors, including friends, family, and neighbors. Angels invested around $600,000 in exchange for equity. They also considered applying for an SBIR award but for various reasons rejected this option, even though NIH had an SBIR solicitation that was specifically related to brain training for children via video games.[262]

Yale then arranged for a presentation with Connecticut Innovations (CI), a state-owned corporation with the authority to invest in companies in various stages of development, created by the Connecticut Legislature in 1989 to provide venture capital to local entrepreneurs.[263] CI reviewed Bruce and his partner's proposal, focusing on technical merit as well as commercial merit, including product features, projected market, and key personnel.[264] CI agreed to give them a $350,000 loan. "*This was critical*," Bruce says. "*It was the biggest single investment we got up to*

260. Their employer would not license them the IP but gave them rights to do noncommercial research. Bruce Interviews, *supra* note 258.

261. Yale will keep all rights to the invention but will freely license the patents to Bruce's company so long as they pay back the costs of the patent application. *Id.* They will also receive a percentage of sales royalties, to diminish over the lifetime of the patents. *Id.*

262. Bruce's main reasons for rejecting the SBIR route were that he did not like the idea of directing his research toward child video games, and that "the SBIR grant was small, and it would take too long to get the money." *Id.*

263. CONN. GEN. STAT. ANN. § 32-32 to 32-47a (West 2010 & Supp. 2014). The legislature created a variety of investing programs to be run by CI, including a Critical Technologies Grant Program, *id.* § 32-41n, an Early-Stage Venture Capital Program, *id.* § 32-41w, and a Pre-Seed Financing Account and Program, CONN. GEN. STAT. ANN. § 32-41x (West Supp. 2014).

264. Patents were less important to CI than other signs of technical and commercial merit. Bruce Interviews, *supra* note 258.

that point."[265] After they got the CI award they also learned that they had received a highly competitive research grant, an NIH "Director's Award" of $5 million, which they had applied for through Yale. The NIH award was only given to 3 percent of applicants, and their anonymous expert reviewer determined that theirs was the "most sophisticated brain training program ever conceived." However, unlike the CI award, Bruce's company could not use the NIH award for commercialization needs.

Bruce's company has started selling a version of the product in various states, including Virginia, Alaska, and California. Over 3,000 children are using it. They currently have around five employees. Four are located in New Haven, where the company has its principal place of business, though they have also added one employee in Florida, where they have a contract with a small marketing firm. They are not profitable currently but hope to be in a few years. They still need to raise significant amounts of capital to fund operations and begin product sales. CI has continued to support them, choosing to convert its loan into equity and giving another $150,000 in operating capital. They are currently seeking a third round of financing from CI, hoping to get $2 million plus, and are also shopping their company to private VCs across the country.

Ongoing concerns include the expense of product tweaking, marketing, and production, and the entry of competitors that have begun to introduce exercise as a major component of their brain-training programs. Although pleased that their program is making an impact, the company founders worry that they will not be the main companies to profit from it.

D. Criticisms of Commercialization Awards

Commercialization awards, particularly at the state level, have been criticized for various reasons.[266] The most significant critiques are all related to the fact that commercialization awards require government to be significantly involved in identifying and valuing new technologies

265. They receive around $40,000 to $50,000 per year to support clinical trials at Yale, and the rest goes to the university and overhead expenses. *Id.*

266. A distinct basis for criticism is that commercialization awards have not produced the desired economic benefits. *See* Enricho Moretti & Daniel J. Wilson, *State Incentives for Innovation, Star Scientists and Jobs: Evidence from Biotech* 2–5, 22–35 (Nat'l Bureau of Econ. Research, Working Paper No. 19294, 2013) (examining the effects of R&D tax credits as well as state incentives for university researchers and subsidies for biotech firms and concluding that many of the benefits resulted from a shifting of activity from state to state rather than real gains); *see also* Camila A. Hrdy, *Do State Incentives for Innovation Work?*, WRITTEN DESCRIPTION (August 23, 2013), http://writtendescription.blogspot.com/2013/08/moretti-wilson-do-state-incentives-for.html (discussing this study and its limits).

with unproven commercial potential.[267] I unpack and respond to this critique below, identifying three separate issues: valuation problems due to government's lack of information, the risk of political influence and/or corruption on award selections, and the fact that awards divert public money from more useful public projects.[268]

1. VALUATION PROBLEMS

As compared to patent alternatives, commercialization awards are what Daniel Hemel and Lisa Larrimore Ouellette call "government-set" incentives.[269] They are awarded by the government for a project and company selected and evaluated by government officials, employees, or contractors.[270] Government-set incentives are widely thought to be inefficient in comparison to other forms of incentives "when the government cannot foresee a potential invention or evaluate its costs and benefits."[271] This can lead to two forms of distortion of investment in innovation: undervaluation, where innovators choose not to pursue the project despite its social value, or overvaluation, which "divert[s] innovators' attention from more useful endeavors."[272]

In deciding whether a government-set incentive is appropriate, the main question to ask is whether this is an area where government can do a good job at evaluating costs and benefits as compared to private markets.[273] Valuing the likely market demand for an invention would indeed seem to be an area where government is not well suited as compared to professional investors. Technology investing is seen as a "high[] skew" endeavor, with very few (perhaps 1 out of 10) projects generating massive returns, and the rest generating very modest

267. *See, e.g.*, Ibrahim, *supra* note 130, at 736.

268. Another question, which I save for Part IV, is whether it is appropriate to spend taxpayer money on promoting commercialization rather than shifting the costs to particular beneficiaries. Hemel & Ouellette, *supra* note 31, at 345–47. This raises highly normative questions about fairness and distributive justice.

269. *Id.* at 327.

270. *See id.*; *see also* Frischmann, *supra* note 1, at 387 ("[G]rants . . . do[] not rely on either the market to signal public demand for innovation-dependent goods or on firms to process and act on such information. Instead the government obtains demand information from the political process, its expert bodies (administrative agencies), and solicitations by researchers.").

271. Hemel & Ouellette, *supra* note 31, at 327.

272. *Id.*

273. *See* Frischmann, *supra* note 1, at 387 n.172; Hemel & Ouellette, *supra* note 31, at 327; Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 73 AM. ECON. REV. 691, 691–92, 697–98, 701 (1983).

returns.[274] This leads some to conclude the only way to succeed in this endeavor is to adopt a "portfolio" strategy that spreads risk among many prospects.[275]

There is no inherent reason government could not be successful at developing portfolios. But as several commentators have noted, there are practical problems that may hinder government's performance when compared to private investors. For instance, in his recent article on VC financing in Silicon Valley, Darian Ibrahim suggests that state venture capital programs are inferior investors to private VCs and angels.[276] The main reasons he gives are that public fund managers will be undercompensated and underskilled compared to private fund managers,[277] and that government officials are likely to interfere with investment decisions. They "may have more incentive to select start-ups for political reasons, including immediate if unsustainable job creation."[278] As a result, government will end up investing in the lemons that the private sector ignores.[279]

To the extent Ibrahim argues government is a comparatively "bad venture capitalist," I do not disagree. The most commercially successful companies will generally *not* be the ones that must turn to public venture capital.[280] Government's portfolios will consequently be lower earning, absent extraordinary circumstances. However, from the public perspective, *this is the point*. The goal of commercialization awards is not to match the returns of private VCs, as Ibrahim's analysis implies.[281]

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274. *See* F.M. Scherer & Dietmar Harhoff, *Technology Policy for a World of Skew-Distribution Outcomes*, 29 RES. POL'Y 559, 559–66 (2000). Following Mansfield's 1977 study, Scherer and Harhoff estimate that "the lion's share of the privately appropriated value through investments in innovation comes from roughly 10% of the technically successful prospects [both for patents and for whole ventures,]" but that "it is difficult to predict in advance which of the prospects . . . will pay off most lucratively." *Id.* at 561.

275. *Id.* at 562 ("Our results also suggest the wisdom for technology policy in Mao Tse-Tung's aphorism, 'Let one hundred flowers bloom' . . . .").

276. Ibrahim, *supra* note 130, at 736–37 (drawing on Ronald Gilson's notion of the proper financial intermediary). Brian Krumm notes very similar downsides of state VC financing programs, especially where government assumes direct responsibility. *See* KRUMM, *supra* note 207, at 14–15.

277. Ibrahim, *supra* note 130, at 736–37.

278. *Id.* at 737 (footnotes omitted).

279. *Id.* at 737–38.

280. *See* Merrill F. Hoopengardner, Note, *Nontraditional Venture Capital: An Economic Development Strategy for Alaska*, 20 ALASKA L. REV. 357, 365–76 (2003) (observing the difference in perceived rates of return among various public VC organizational structures as contrasted with traditional private VC).

281. I am not criticizing Ibrahim's analysis. He was not discussing state VCs *as an innovation policy* to correct market failure. He was simply comparing their performance to private investors.

Rather, as Lerner's and Zieodnis's work emphasizes, the role of public financing for technology development is to resolve the market failures in commercialization discussed above.[282] Accordingly, award recipients should not be those companies that private investors would have supported without government help. Rather, the ideal award recipient is the "marginal commercializer" defined above.

The real problem is that government cannot identify marginal commercializers. It may give money to horrible companies that will not survive even one year, on the one hand, or amazing companies that would have received private investment anyway, on the other. Like other government subsidies, this leads to deadweight loss, defined in this context as foregone taxpayer revenues for commercialization awards that do not produce greater or equal public benefits.[283] This leads to the more difficult question: will the deadweight loss produced by government's misallocations in granting commercialization awards be worse than the deadweight loss and dynamic inefficiencies generated by alternative incentive mechanisms? This question cannot be answered simply by saying "government is a bad venture capitalist." Instead, we have to compare alternatives for resolving the same market failures. I do this in Part IV, where I compare the efficiency of commercialization awards to commercialization patents.

2. POLITICAL INFLUENCE

A second critique, just alluded to, is that politicians will exert influence on award administrators to select companies for political reasons.[284] Notwithstanding Zhao and Ziedonis's positive findings about the Michigan program, at least two other state award programs have been accused of political corruption. For example, the Indiana 21st Century Fund's chairman allegedly gave funds to a "well-connected businessman and Republican campaign donor" and his son.[285] Governor Rick Perry

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282. Lerner, *The Government as Venture Capitalist*, *supra* note 37, at 290–92; Zhao & Ziedonis, *supra* note 37, at 2; *see also* BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION, *supra* note 14, at 2.

283. MANKIW, *supra* note 18, at 159–60.

284. Public choice theory predicts that commercialization awards will go to small, concentrated groups who excel at lobbying—not necessarily deserving companies and entrepreneurs in actual need. Brian Galle, *The Tragedy of the Carrots: Economics and Politics in the Choice of Price Instruments*, 64 STAN. L. REV. 797, 840 (2012) (applying public choice theory to subsidies for producers of positive externalities).

285. Alex Campbell, *IEDC Contractor Steers Indiana Investment Funds to Firms Run by Its Chairman and His Son*, INDYSTAR (June 19, 2014, 7:37 PM), http://www.indystar.com/story/news/2013/11/01/iedc-contractor-steers-indiana-investment-funds-to-firms-run-by-its-chairman-and-his-son/3348817/. Bates allegedly received

was accused of giving Texas Commercialization Awards to friends and campaign donors.[286] Along with the usual desire to make friends and raise money, intense interjurisdictional competition for mobile businesses provides another explanation for local politicians' attempts to influence where awards go.[287]

There is no way to deny that political influence is a problem. However, design features can be implemented to reduce political influence on award programs. Several were flagged above, including strict matching requirements, small awards calibrated to demonstrated need, and staged financing based on performance. When states do not contract out to professional managers, they should require funds to be overseen by widely representative committees with fully independent members.[288] There should also be some mechanism to protect against changing winds upon re-election. For example, state trust funds could be used to create long-term, stable funding commitments.[289]

3. IS GOVERNMENT OPPORTUNITY COST TOO HIGH?

Even if government can do a reasonably good job at awarding marginal commercializers to spur innovation and economic activity, providing ex ante financing to individual technology companies is

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$500,000 in taxpayer money from an Elevate-run fund. *Id.* A company run by Bates's son allegedly received $300,000 from Elevate. For a recent report on these allegations, see *id.*

286. *See The Fire of Corruption Rages in Rick Perry's Texas*, *supra* note 245.

287. *See* Editorial, *Farewell, Ambassador Perry*, BUS. WK., July 15–21, 2013, at 26 (describing Perry's practice of luring companies to his state with promises of tax credits, etc.). As Brian Galle observes, local incentives in the form of *subsidies* (for example, tax credits, commercialization awards) are especially vulnerable to unproductive rent seeking by mobile firms that threaten to locate in other states if not rewarded. *See* Galle, *supra* note 284, at 841–43.

288. For instance, in response to the allegations of corruption mentioned above, the Texas Legislature altered the structure of the fund to limit the governor's direct involvement in selecting winners and increased annual reporting requirements. The fund is now administered by the more independent Texas Emerging Technology Advisory Committee. The Committee is composed of 17 members appointed by the governor, the lieutenant governor, the speaker of the house of representatives, and selected "industry leaders." *See* TEX. GOV. CODE § 490.051–052 (2011). On the TETF advisory committee, see *Texas Emerging Technology Fund - Advisory Committee*, OFF. GOVERNOR, http://gov.texas.gov/ecodev/etf/etf_advisory_committee (last visited Feb. 15, 2015). *See also* OFFICE OF THE GOVERNOR, ECON. DEV. & TOURISM, *supra* note 245, at 1.

289. On state use of trust funds to ensure long-term funding commitments in various contexts, see Michael J. Graetz, *Trusting the Courts: Redressing the State Court Funding Crisis*, 143 DAEDALUS J. AM. ACAD. ARTS & SCI. 96, 101 & n.29 (2014) (citing ERIC M. PATASHNIK, PUTTING TRUST IN THE U.S. BUDGET: FEDERAL TRUST FUNDS AND THE POLITICS OF COMMITMENT (2000); Susanna Camic Tahk, *Public Choice Theory and Earmarked Taxes* (Univ. of Wis. Legal Studies Research Paper, 2014), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2311372).

undeniably a high-risk operation.[290] As a practical matter, the political risk associated with losing taxpayer money in any particular case will make the prospect of a one in ten success rate unappealing for most politicians.[291] The political risks associated with government technology investing may be one reason the federal government limits the size of SBIR awards and restricts them to small businesses.[292] Notably, since 2008, funding for SBIR has decreased by as much as $126 billion amidst wrangling over the budget.[293]

Beside practical politics, there is an important reason why government's risk threshold should arguably be lower than private firms': government's opportunity cost is very high. Unlike private investors, government is charged with spending public money and can use those funds in socially productive ways—many of which might be a better way to promote innovation and commercialization of inventions than direct financing. The most obvious alternative is to provide subsidies for education.[294] Another is to improve workforce education and training and increase the capacity of local populations to work at

290. This is similar for research grants. As Brett Frischmann puts it, writing about grants for research, "[W]hen utilizing grants, the government, as investor-principal, often bears the entire downside risk of an unsuccessful project." Frischmann, *supra* note 1, at 387.

291. As Scherer and Harhoff put it, "Legislators and senior government leaders," unlike VCs, "are likely to view government technology programs in which half the supported projects fail to yield appreciable returns and only one in 10 succeeds handsomely as a rather poor track record." Scherer and Harhoff, *supra* note 274, at 561–62.

292. *See* BERGLUND & COBURN, *supra* note 207, at 483 (noting the federal government's slow entry into cooperative technology development programs that directly engage industry for the express purpose of enhancing economic growth); BRANSCOMB & AUERSWALD, TAKING TECHNICAL RISKS, *supra* note 14, at 144 ("[F]ederal politics views with suspicion government programs to assist individual firms.").

293. SCHMIDT TESTIMONY, *supra* note 27, at 5.

294. MANKIW, *supra* note 18, at 199–200 (discussing externalities of education including higher productivity and wages, more informed voters, and development and dissemination of technological advances); *see also, e.g.*, Editorial, *Kansas' Ruinous Tax Cuts*, N.Y. TIMES, July 14, 2014, at A18 ("With less money to spend [as a result of state subsidies for companies], Kansas is forced to chop away at its only hope for real economic expansion: investment in public schools and colleges.").

innovative firms.[295] A very cheap option for helping technology entrepreneurs is to provide know-how rather than money.[296]

States already offer a variety of guidance and networking programs to help small businesses get information and access private capital.[297] For instance, Oklahoma provides Oklahoma companies with technology assessment, business model evaluation, and help locating financing.[298] Oklahoma also runs an "Inventor's Assistance Program," which provides patent searches, business counseling, and "any other assistance necessary to develop the product to the commercial stage."[299] Vermont's Small Business Development Center (SBDC) does not provide any funding at all but "provides no-cost, confidential business advising and low-cost training services to all small businesses and new ventures in Vermont," including help applying for funding through the SBIR or STTR programs.[300]

The "know-how versus money" approach likely benefits start-ups in spaces like IT, where costs are low. But it may be of limited help to companies developing science-based research with long testing times, high up-front costs, and significant lab space requirements. If government chooses to offer financial incentives for marginal commercializers in a broader spectrum of technology fields, then the question is, again, how best to do it: commercialization awards or some other incentive like commercialization patents? This is the subject of Part IV.

IV. COMPARING COMMERCIALIZATION INCENTIVES

Having established that market failures exist in commercializing inventions and that government already employs commercialization

295. *See* LOBEL, supra note 171, at 9 (stressing import of trained, talented individuals); Susana Borrás & Charles Edquist, *Education, Training and Skills in Innovation Policy*, SCI. & PUB. POL'Y, July 15, 2014, at 1–2, 6 ("focus[ing] on competence and competence building from the perspective of innovation systems"); Peter Downs, *Can't Find Skilled Workers? Start an Apprentice Program*, WALL ST. J., Jan. 17, 2014, at A13 (discussing apprentice programs in other countries and in St. Louis).

296. Abraham Cable has made a similar suggestion to focus on cheaper policies such as technology infrastructure for entrepreneurs. Cable, *supra* note 22, at 249.

297. BERGLUND & COBURN, *supra* note 207, at 27–31 (discussing start-up assistance and incubators and state networking programs).

298. OKLA. STAT. ANN. tit. 74, § 5064.4 (West 2014).

299. *Id.* § 5064.4(B)(2); *see also Oklahoma Technology Commercialization Center*, *supra* note 214.

300. VERMONT SMALL BUS. DEV. CENTER, http://www.vtsbdc.org/ (last visited Feb. 15, 2015); *see also Small Business Technology and Commercialization*, VERMONT SMALL BUS. DEV. CENTER, http://www.vtsbdc.org/programs/small-business-technology-commercialization (last visited Feb. 15, 2015).

awards, the final issue to address is how awards compare to other options for achieving the same goal. As explained in Part I.C, patent law scholars have proposed using IP-based incentives to promote commercialization of inventions and spur entrepreneurial activity. In this Part, I analyze how proposed commercialization patent models compare to existing commercialization awards as responses to the commercialization market failures identified in Part II: externalities, transaction costs in IP licensing, and capital market frictions that limit commercialization of inventions, especially for entrepreneurs.

A. Commercialization Patents

1. PROMOTING MARKET EXPERIMENTATION

The main way commercialization patents would promote commercialization is by significantly reducing investment risk associated with generating new information that is not covered by invention patents. As explained, patent commercialization theory since Kitch has emphasized the risk of "free riding" on information produced during commercialization.[301] But with the important exception of business method patents,[302] patents for inventions are limited to the "novel" and "nonobvious" aspects of a technological innovation.[303] Commercialization patents cover far more information, including information that is only produced once an innovation is commercialized, such as information produced during market experimentation.[304] This creates a new opportunity for significant economic market power—the ability to charge prices above marginal cost—along with licensing royalties and returns from enforcement against infringers.[305] By reducing the risk and increasing the expected reward of any commercial undertaking involving subject matter that qualifies for protection,[306] this

301. *See supra* Part I.B.

302. Abramowicz & Duffy, *supra* note 5, at 400–07 (discussing ways that patents already reward "commercially nonobvious" innovations like business methods).

303. *See* 35 U.S.C. §§ 101–103 (2012); *supra* Part II.A.

304. Abramowicz & Duffy, *supra* note 5, at 400–07 (emphasizing the need for patents to protect investments in market experimentation); *see also id.* at 339 n.4 (defining market experimentation). On the information produced only through working patents, see Duffy, *supra* note 79, at 1359.

305. Invention patents are said not to confer automatically a monopoly or market power of economic relevance in any particular market. *See Ill. Tool Works, Inc. v. Indep. Ink, Inc*., 547 U.S. 28 (2006) (holding that patents do not imply a presumption of market power under the Sherman Antitrust Act).

306. Subject matter would include "commercially nonobvious" information, *see* Abramowicz & Duffy, *supra* note 5, at 406, or "substantially novel" products whose

incentive should increase the chances that inventors of any kind will invest in further developing and marketing innovations that might benefit second movers if commercialization is successful.[307] At the least, the availability of commercialization patents should accelerate the pace at which this process occurs.[308]

In theory, the boosted incentive should be of value to entrepreneurs along with large corporations because the prospect of obtaining an effective monopoly in the future should make outside investors more likely to agree to fund the project at the outset. Moreover, entrepreneurs could more freely disclose all the aspects of their business model to investors, secure in the knowledge that patent remedies like compensatory damages and injunctive relief will be available if the information is used illicitly.[309] Additionally, according to signal theory, commercialization patents could reduce informational asymmetries further by signaling the quality of a venture to investors, garnering attention for entrepreneurs that they might not otherwise receive.[310] Another way commercialization patents should promote commercialization is by reducing transaction costs for commercializers attempting to license pre-existing invention patents.[311] This might provide the most marginal benefits for entrepreneurs and small businesses with fewer networks and resources for licensing.

Another public benefit of commercialization patents suggested by Kitch's, Merges's, and Kieff's work is that commercialization patents could result in more efficient allocation of investment resources by creating fully alienable property rights in new information produced during commercialization.[312] Commercialization patent owners that are

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underlying inventions are potentially patentable (or already patented) but have not yet been commercialized, Sichelman, *supra* note 4, at 346.

307. For an analysis of how patents alter the risk-assessment calculus for the marginal inventor, see Merges, *Uncertainty and the Standard of Patentability*, *supra* note 89, at 9. *See also* Chiang, *supra* note 84, at 72–75 (discussing the effect of patents on incentives to undertake research in the presence of uncertainty).

308. On the role of patents as being able to accelerate innovation, see Abramowicz & Duffy, *The Inducement Standard of Patentability*, *supra* note 84, at 1599 and Chiang, *supra* note 84, at 57–58 (observing that the "patent system creates no inventions, it *accelerates* them").

309. Kitch, *supra* note 1, at 277; Merges, *A Transactional View of Property Rights*, *supra* note 89, at 1500–13.

310. *See supra* note 96 and accompanying text.

311. Abramowicz & Duffy's proposal uses doctrinal rules governed by courts. *See* Abramowicz & Duffy, *supra* note 5, at 403–04. Sichelman's proposal endows successful commercializers with immunity from injunctions based on underlying invention patents, requiring only payment of a reasonable royalty. Sichelman, *supra* note 4, at 346.

312. *See* Kieff, *supra* note 80, at 703; Kitch, *supra* note 1, at 277; Merges, *A Transactional View of Property Rights*, *supra* note 89, at 1481.

not well suited to commercialize themselves could transfer or license their rights to those who can do so more efficiently.[313] According to prospect theory, so long as they are granted sufficiently early in the commercialization process, commercialization patents could also reduce wasteful duplication of effort by signaling to others that a project has been "prospected."[314]

2. BUT WOULD COMMERCIALIZATION PATENTS HELP ENTREPRENEURS?

On the other hand, commercialization patents have significant downsides, especially with respect to the challenges faced by start-ups and relatively unproven entrepreneurs in commercializing inventions.

First, although commercialization patents protect more information than invention patents and would, in Abramowicz and Duffy's iteration, apply to nontechnological information, they would provide no incentive for innovations that would not qualify for a commercialization patent in the first place or for which exclusivity with disclosure is a weak incentive.[315] Thus, for instance, if the innovation is a new method of checking the status of patients in a hospital that is not patentable or only weakly patentable, commercialization patents would make no difference, even if successful adoption of the innovation would generate new information and social utility.[316]

Second, commercialization patents are not limited to inventors and start-ups that are unable to commercialize their inventions in the absence of government incentive. They might go to firms with the resources to invest in commercialization and for which transaction costs in IP licensing and fundraising are not problems.[317] This could lead to reduced competition and innovation without corresponding social benefit

313. *See, e.g.*, Risch, *Licensing Acquired Patents*, *supra* note 93, at 979–80 (discussing various theories about the commercialization benefits of patent licensing by entities that acquire patents in different contexts, including for commercialization purposes).

314. Kitch, *supra* note 1, at 276.

315. On unpatentable innovations left out by the patent system, see, for example, Douglas Gary Lichtman, *The Economics of Innovation: Protecting Unpatentable Goods*, 81 MINN. L. REV. 693, 693 (1997) (proposing allowing state anti-copying laws to promote investment in unpatentable goods).

316. *See* Kapczynski & Syed, *supra* note 68, at 1902–03 (on medical innovations and other socially valuable subject matter for which exclusivity is not a useful incentive).

317. A first-to-file versus first-to-invent rule for commercialization patents could exacerbate this issue if large corporations have more resources to file early. David S. Abrams & R. Polk Wagner, *Poisoning the Next Apple? The America Invents Act and Individual Inventors*, 65 STAN. L. REV. 517, 517 (2013) (finding a significant drop in the fraction of patents granted to small inventors in Canada coincident with the implementation of first-to-file).

(deadweight loss). To make this concrete, imagine that, instead of raising money from investors and disrupting the taxicab market through good execution and savvy business strategy, Uber had obtained a commercialization patent for its new ride-sharing service.[318] Even if the patent lasted for only five to eight years, Uber's commercialization patent would have produced monopoly pricing and hindered future innovations without any justification, since Uber would have obtained financing anyway. We would have no competitors like Lyft to drive down the price of ride sharing and force Uber to keep innovating.[319] This would have been a deadweight loss patent. Without introducing a preference for needful patentees or doctrinal levers to perform a similar function,[320] commercialization patents would inevitably cause some of these situations.

Third, to the extent that commercialization patents do go to those who really need them—marginal commercializers—they provide no cash up front. Like other "ex post" incentives, they provide no financial benefit until and unless marketing of the invention is successful.[321] This could be a serious problem for start-ups experiencing funding gaps in ESTD and commercialization.[322] As explained above, patent commercialization theories suggest commercialization patents could nonetheless help entrepreneurs raise financing ex ante to commercialization by permitting free disclosure and creating signals to investors.[323] However, it is not clear how much investors care about patents or whether patent signals have intrinsic value, with empirical

318. Uber is a new ride-sharing service that lets riders use apps on their mobile phones to contact an Uber driver in the area who shows up in a privately owned vehicle and drives the rider where he or she wants to go. *See* Steven Greenhouse, *Taxi Driver Solidarity: Pinched by Ride-Sharing Services, Cabbies Seek a National Union*, N.Y. TIMES, June 7, 2014, at B1; *see also* Michael J. de la Merced, *Uber Attains Eye-Popping New Levels of Funding*, N.Y. TIMES, June 7, 2014, at B1 (reporting that Uber has raised $1.2 billion from investors and has a $17 billion valuation). For an update on financing, see Mike Isaac & Michael J. de la Merced, *Uber Adds a Billion Dollars More to Its Coffers*, N.Y. TIMES, Dec. 5, 2014, at B1.

319. The current market has several competitors, including Uber, newcomers like Lyft, and taxicab medallions, which in some cities are "developing apps and sprucing up vehicles in expectation that competition is coming anyway [from the ride-sharing entrants]." Holman W. Jenkins, Jr., *What the Taxi Wars Teach*, Op-ed, WALL ST. J., Aug. 20, 2014, at A11.

320. *See* Abramowicz & Duffy, *supra* note 84, at 1599 (proposing a nonobviousness standard to weed out patents that do not induce innovation).

321. On "ex post" incentives, see Hemel & Ouellette, *supra* note 31, at 333–34 (explaining that with ex post patents money changes hands only after a successful product is developed).

322. BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION, *supra* note 14, at 1–5.

323. *See supra* notes 95–96 and accompanying text.

studies coming to divergent conclusions.[324] Then again, commercialization patents might provide more attention-getting or more accurate signals of a company's inherent value.

Finally, as explained above, commercialization patents are partly motivated by the desire to reduce the transaction costs created by existing patents on inventions.[325] Yet obviously commercialization patents themselves create new transaction costs for innovators other than commercialization patent holders.[326] To take the Uber example again, assume Uber is willing to license to Lyft, but they cannot agree on a price and the deal breaks down.[327] This new market failure could far outweigh any benefits created by reducing Uber's own struggles in licensing inventions patents, if any, on ride-sharing service software.

B. Commercialization Awards

1. TARGETING MARGINAL COMMERCIALIZERS

Commercialization awards use a different strategy to resolve similar commercialization market failures. Instead of increasing appropriability through property rights, they supply small amounts of funding in the form of cash, loans, or equity, providing capital in exchange for the promise to exercise best efforts to commercialize in the reasonably near future.[328] Unlike commercialization patents, they specifically target new and young companies experiencing funding gaps before they have a marketable prototype or business model that can attract private investors.[329] As explained above, they require equal co-investment from private sources, which helps government mitigate the risk of poor

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324. *See* Graham et al., *supra* note 13, at 1288–314 (reporting results of surveys suggesting early-stage companies patent for multiple reasons, including securing financing and enhancing reputation, and suggesting that patents are perceived to be particularly important in securing financing in biotech and medical devices). *But see* Ronald J. Mann, *Do Patents Facilitate Financing in the Software Industry?*, 83 TEX. L. REV. 961, 976–77 (2005) (suggesting that in the software industry patents are not relied on to the same degree by investors especially compared with other indicators like first-mover advantage).

325. *See supra* Part II.C.2.

326. Merges, *supra* note 163, at 2654–60.

327. *See, e.g.*, Robert Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75, 75 (1994) (discussing various kinds of breakdown in patent licensing that can occur between the holder of an original patent and the holder of a related improvement patent).

328. On "ex ante" incentives like grants, see Hemel & Ouellette, *supra* note 31, at 333–34.

329. BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION, *supra* note 14, at 1; *see also, e.g.*, Zhao & Ziedonis, *supra* note 37, at 4–5 (explaining the goal of awards to alleviate capital constraints for entrepreneurs).

valuations.[330] Awards are also believed to produce a "certification effect" that makes it easier for recipients to raise money as a result of the government's interest in the company.[331]

For a large corporation deciding whether to invest in developing and marketing an innovation, an award of $10,000 to $1 million would probably not make much difference. But for an entrepreneur seeking small amounts of capital to do more research and continue operations before profitability, this amount can represent a critical input. While commercialization awards may have a far lower impact than commercialization patents on overall levels of market experimentation, by funding these "marginal commercializers," they probably do accelerate the pace at which innovations reach the public, especially since they target the sector of the business community that is thought to produce the most economically significant innovation.[332]

2. MIXING PUBLIC AND PRIVATE GOALS

Another important distinction of commercialization awards is that they are not necessarily awarded to those innovations with the greatest commercial potential. Instead, they specifically target innovations that government believes are likely to generate long-term social spillovers, such as innovations in public health, nanoscience, or 3D printing, or innovations that correspond with government imperatives, such as defense.[333] In other words, commercialization awards do what patents do not do presently: they allow the government to mix public and private goals by granting special privileges to developers of technology with expected public utility.[334]

3. BUT CAN GOVERNMENT DO IT?

When compared to commercialization patents, commercialization awards have significant downsides. The main objection is that awards are

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330. On matching, see Part III.B.3.

331. *See* Zhao & Ziedonis, *supra* note 37, at 17–19 (discussing how government R&D awards are thought to reduce informational problems in entrepreneurial capital markets by producing certification effects).

332. *See, e.g.*, Glaeser & Kerr, *supra* note 42, at 26; *see also supra* Part II.C.3; *supra* Part III.C.1 (discussing empirical studies on SBIR and Michigan awards).

333. *See* Kelley, *supra* note 26, at 315–19.

334. *See* Mario Biagioli, *Patent Republic: Representing Inventions, Constructing Rights and Authors*, 73 SOC. RES. 1129, 1138 (2006); Oren Bracha, *The Commodification of Patents 1600–1836: How Patents Became Rights and Why We Should Care*, 38 LOY. L.A. L. REV. 177, 243 (2004); Camilla A. Hrdy, *State Patents in the Age of Laissez Faire*, 28 BERKELEY TECH. L.J. 45, 62–66 (2013).

government-set versus market-set incentives, meaning they do not rely solely on private information and decentralized markets to value inventions' commercial potential.[335] As explained in Part III.D, there are indeed many reasons to doubt government's abilities as a "venture capitalist" compared to private investors, and government's opportunity cost in spending public money is very high.[336] However, again, awards should not go to the best companies; they should go to the companies that investors turned down despite at least some commercial promise. To the extent that we doubt government's comparative efficacy at evaluating commercial potential and the effects of political influence on the selection process, I suggest that standardized, strictly enforced matching requirements, which most state programs already use, are an effective solution. Matching reduces the risk of funding companies that will fail in a short period, the potential for politicians to exert influence, and the need for long-term government monitoring.[337]

A second issue is that, because commercialization awards do not create exclusive rights in new information whose scope is defined by a specification, they do not necessarily encourage or permit free disclosure of all information related to practicing and marketing an invention and do not create a property-rights-based mechanism for transferring that information to more efficient utilizers.[338] Yet, as explained in Part I, commercialization, like invention, can produce valuable new information, including information related to methods of production, entering new product markets, and practical knowledge about how inventions actually work in fully commercialized form.[339] This information will be free for others to copy and use as soon as it is disclosed to investors and put into public use. Therefore, it may be

335. Hemel & Ouellette, *supra* note 31, at 327.

336. *See supra* Part III.D.

337. Many policy analysts look positively on matching as a way for government "to provide sufficient investment funds in a risky environment without losing the monitoring ability of venture capital firms and without trying to implement such monitoring with clumsy and costly contracts or administrative mechanisms." Martin & Scott, *supra* note 19, at 440–41 (discussing proposed matching mechanism); *see also, e.g.*, LERNER, BOULEVARD OF BROKEN DREAMS: WHY PUBLIC EFFORTS TO BOOST ENTREPRENEURSHIP AND VENTURE CAPITAL HAVE FAILED AND WHAT TO DO ABOUT IT, *supra* note 37, at 181–90; *see also* Ibrahim, *supra* note 130, at 737–38 (noting that when government provides only matching funds it can increase returns, though concluding this will not significantly improve government's performance as compared to private investors); KRUMM, *supra* note 207, at 16 (noting that partnering with private investors can improve due diligence and "insure that politicians do not influence the fund's investment decisions").

338. *See, e.g.*, Kieff, *supra* note 80, at 703.

339. *See* Duffy, *supra* note 79, at 1395 (discussing MICHAEL POLYANI, THE TACIT DIMENSION 4 (1966) (suggesting that people know more than they can communicate to others)).

difficult and financially unappealing for commercializers to disclose and transfer new information they derive through the process of commercialization itself.

If the result is less information than would otherwise be produced and disclosed, I concede this is a tradeoff. But there are a few mitigating factors. First, with respect to IP for market experimentation, as Abramowicz and Duffy point out, much of this information can already be protected and transferred using invention patents for business methods.[340] And, as Burstein has recently discussed, there are many ways to exchange information short of creating new IPR, such as nondisclosure agreements, social norms that dissuade copying, and licensing contracts.[341]

With respect to Sichelman's model, if the purpose of commercialization patents is to provide exclusive rights "in exchange for the commitment to make and sell a substantially novel product,"[342] then the same entity that obtains the patent will also be the commercializer. So long as they can raise funding, a new mechanism for transferring commercialization rights should not be required.

A final objection is that commercialization awards do not create a new legal mechanism for reducing transaction costs between commercializers and holders of invention patents.[343] However, I am not convinced this requires any new legislative solution. Courts already have discretion in awarding patent injunctions, especially when nonpracticing entities are involved.[344] Many argue that even these limits are unnecessary in light of private-ordering solutions in the form of patent pools and standard-setting organizations that have emerged in significant number to make licensing patents cheaper and less time consuming.[345]

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340. *See* Abramowicz & Duffy, *supra* note 5, at 344. Business method patents cover far more than invention already. *See id.* at 368–69.

341. *See* Burstein, *supra* note 1, at 262–74 (discussing various non-IP strategies for protecting the interests of the parties during information exchange: contracts, social norms, and alternative sources of appropriability).

342. *See* Sichelman, *supra* note 4, at 341.

343. *See id.* at 404–06 (describing that immunities commercialization patents would produce as against invention patents).

344. In *eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388 (2006), the Supreme Court eliminated a long-standing rule of federal patent law allowing automatic permanent injunctions, introducing discretion in the courts to award or not award depending in part on whether the patentee practiced the invention. *Id.* at 396–97 (Kennedy, J., concurring).

345. Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CALIF. L. REV. 1293 (1996); *see also* Gupta, *supra* note 165, at 827–58 (discussing private ordering solutions); Michael Mattioli, *Communities of Innovation*, 106 NW. L. REV. 103, 119–30 (2012) (using case studies of various patent pools to investigate Merges's thesis about collective rights organization empirically).

Even if invention patents are significantly hindering commercialization by start-ups and small businesses, as some commentators suggest,[346] introducing new IPR for commercializers seems like a blunt tool for confronting this problem. There are less burdensome options, such as a revived "paper patent" doctrine that disfavors unworked patents in favor of worked patents.[347]

C. Summary of Costs and Benefits

Can we conclude which incentive is the better policy? If accurate "pricing" of inventions is our main concern, then commercialization patents might be superior in the short term because they directly rely on markets versus government to determine the demand for an invention.[348] But they also produce deadweight loss for consumers in the absence of perfect price discrimination and create dynamic inefficiencies by restricting competition and hindering others' productive reuses.[349] Commercialization awards, in contrast, require government (albeit with private matching as a guide) to make uncertain ex ante determinations of commercial viability. As such, they create deadweight loss in the form of misallocated government funds and distortion of investment in innovation.[350]

In order to determine definitively which mechanism is more efficient, more experimentation would be required.[351] But in the meantime, deciding which is more efficient requires deciding which market failure we theoretically think is more important. Insufficient commercial risk taking due to the difficulty of appropriating information

346. *See* James Bessen & Michael J. Meurer, *The Direct Costs from NPE Disputes*, 99 CORNELL L. REV. 387 (2014); Colleen Chien, *Startups and Patent Trolls*, 17 STAN. TECH. L. REV. 461 (2014). *But see* David L. Schwartz & Jay P. Késan, *Analyzing the Role of NPE's in the Patent System*, Essay, 99 CORNELL L. REV. 425 (2014).

347. *See* Duffy, *supra* note 79, at 1359; *see also* Abramowicz & Duffy, *The Inducement Standard of Patentability*, *supra* note 84, at 1673–76 (arguing that the standard of patentability should take into account the extent to which an invention achieved commercial success through effort of the patent holder).

348. Nancy Gallini & Suzanne Scotchmer, *Intellectual Property: When Is It the Best Incentive System?*, *in* 2 INNOVATION POLICY AND THE ECONOMY 51, 70 (Adam B. Jaffe, Joshua Lerner & Scott Stern eds., 2002); SCOTCHMER, *supra* note 31, at 85.

349. Frischmann & Lemley, *supra* note 43, at 258–77; Kapczynski, *supra* note 31, at 979–80.

350. Frischmann, *supra* note 1, at 387; Hemel & Ouellette, *supra* note 31, at 327.

351. It could be possible to use an "experimentalist" policy approach, as Ouellette has suggested. For instance, governments could introduce commercialization patents in distinct regions in order to obtain data on their efficacy as compared to regions in which commercialization awards are offered. Ouellette, *supra* note 39.

related to commercializing? Transaction costs in IP licensing? Or break down in capital markets for entrepreneurs?

The table in the Appendix summarizes the two distinct responses to these market failures. In short, commercialization patents are very good at internalizing spillovers and inducing extraordinary market risk taking across the board. They also create new ways to reduce transaction costs in IP licensing, though, as explained, I consider this benefit relatively insignificant and possibly negative, given that other mechanisms perform the same function and that commercialization patents themselves can create new transaction costs in licensing markets.[352] Meanwhile, commercialization awards do not promote generation, let alone disclosure, of commercially groundbreaking information and thus may produce fewer market-shaking innovations like Netflix or Uber. However, they are a reasonably effective way for government to provide entrepreneurs with up-front financing to commercialize inventions that government also thinks are important. From the private perspective, awards extend company lifetimes and create certification effects that facilitate further private sector financing. From the public perspective, awards may generate longer-term economic benefits and more significantly improve standards of living.

If government wants to spur more commercial risk taking across the board, with the long-term goal of boosting the generation, disclosure, and transfer of new information, then new forms of IPR for "commercially nonobvious" information might be warranted, as Abramowicz and Duffy suggest. Of course, as Sichelman notes, administering such a system in practice has a downside similar to that of commercialization awards: it requires the Patent Office to "make 'judgments about market viability' and other aspects of commercialization with which the Patent Office has no expertise."[353] This might lead us to favor Sichelman's proposal for commercialization patents—though here we have the problem of distorting investment further toward the same kinds of subject matter that already qualifies for invention patents. As Lee and others have discussed, this may underreward social innovations that do not qualify for patents.[354]

On the other hand, if government wishes to support technology entrepreneurship and direct funding toward socially significant innovations, regardless of patentability, then commercialization awards should be preferred. As explained, involving government in directing the course of innovation is risky and may lead to misallocated government

352. *See supra* Part II.C.2.

353. Sichelman, *supra* note 4, at 397.

354. *See, e.g.*, Lichtman, *supra* note 315, at 693.

money.[355] But it could potentially be a boon for long-run innovation policy, both by preferring entrepreneurs over incumbents and by allowing government to mix public and private goals. The fact is that even the highest-risk investors are likely to have a preference for innovations that turn quick profits in the near future.[356] This may lead them away from ground-breaking innovations such as the steamboat or the computer.[357] An example is the case study presented in this Article, in which the government chose to award a scientist developing a brain-training program for children with autism. This invention may not be as valuable to VCs as a new kind of smart phone; but it may produce more social benefits in the long run, along with being commercially viable.

Importantly, from the perspective of innovation policy, companies need not survive into infinity for awards to produce social benefits. If the main goal is to generate new information that can be copied by others, then surviving in a market for five years is better than never getting off the ground at all. For instance, in my case study, if the faculty entrepreneur's company eventually goes out of business as a result of emerging competitors, he will have introduced a market innovation that will benefit children with autism, later generations of children with autism, and the community of New Haven, Connecticut, where his company is located.

Without veering too far from the Article's utilitarian focus, commercialization awards also may be justifiable on grounds of fairness and distributive justice.[358] One of the benefits of commercialization patents would be to avoid taxing the general populace to pay for commercialization of innovations that only a selection of the populace actually uses.[359] Commercialization awards, which draw on taxpayer funds, appear to lack this "user pays" feature.[360] But the situation is more complicated. Unlike mere invention and disclosure, commercialization

355. *See supra* note 34 and accompanying text.

356. *See* Gilson, *supra* note 130, at 1074–75.

357. *See* Hrdy, *supra* note 334, at 107 (analyzing a state's decision to provide a monopoly on the steamboat as correcting market failure). On innovation beyond markets, see, for example, Kapczynski & Syed, *supra* note 68, at 1900.

358. This argument is influenced by Jeremy Sheff's recent suggestion that patents' "user pays" feature is supported by distributive justice. *See* Jeremy Sheff, *Who Should Pay for Progress?* (Aug. 7, 2014) (unpublished abstract), http://www.law.berkeley.edu/files/Sheff_Jeremy.pdf.

359. Hemel & Ouellette, *supra* note 31, at 346 ("Of the principle policy mechanisms discussed above, the patent system is unique in that the payors are purchasers of the patented products, such that the patent system limits the extent to which non-users subsidize users." (footnote omitted)) (discussing Gallini & Schotchmer).

360. *See id.* at 308 (noting that "user pays" features can be incorporated into other incentives).

potentially produces direct economic benefits in the near term, especially in the region in which the commercializer locates, including jobs, taxpayer revenues, and agglomeration benefits for surrounding firms and residents.[361] Thus, asking taxpayers to directly finance entrepreneurs that start businesses and spur economic activity in their communities seems like a reasonable application of the "benefits principle" of taxation: those who benefit pay.[362]

CONCLUSION

This Article has made several important contributions. First, this Article summarizes patent commercialization theory since Kitch and shows how various features of Kitch's original ideas and subsequent scholarship have been used to argue for new patent-based incentives to promote commercialization of inventions. Second, this Article responds to Lemley's influential critique of "ex post" justifications for IP, identifying three classic forms of market failure that might warrant government intervention to ensure efficient levels of commercialization: positive externalities in commercialization that remain unprotected by traditional patents, transaction costs in IPR licensing markets that make it difficult to commercialize certain inventions, and information and trust asymmetries that impede entrepreneurs' ability to raise financing in private capital markets. Third, this Article shows that, to the extent these market failures exist, there are a variety of existing mechanisms for resolving them. VCs have become a crucial source of financing for ventures involving high-risk technology development.[363] Invention patents, especially business method patents, already protect at least some commercially novel aspects of these inventions both during fundraising and during marketing.[364] Lastly, as this Article demonstrates, nonpatent incentives in the form of federal procurement programs and state commercialization awards already provide supplemental sources of commercialization financing when markets fail.[365]

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361. *See supra* Part III.B.2.

362. *See, e.g.*, ROBERT D. COOTER, THE STRATEGIC CONSTITUTION 105–06 (2000) (discussing taxation of national versus local public goods).

363. *See* Gilson, *supra* note 130, at 1068 (discussing VC firms); Ibrahim, *supra* note 130, at 720–21 (discussing angel investors).

364. Abramowicz & Duffy, *supra* note 5, at 405; *see also* Merges, *A Transactional View of Property Rights*, *supra* note 89, at 1519–20.

365. *See, e.g.*, BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION, *supra* note 14, at 41–55; *see also* Lewis Branscomb, *Where Do High Tech Commercial Innovations Come From?*, 5 DUKE L. & TECH. REV. ¶ 12 (2004) (discussing debates over whether public financing such as ATP is needed to supplement private capital markets for high-tech start-ups).

Although this Article does not definitively resolve which mechanism is more efficient, it suggests that commercialization awards work reasonably well if the primary goal is to help technology entrepreneurs who are experiencing funding gaps prior to commercial viability. Contrary to some critics' assessments, award recipients need not, and indeed should not, be the "best" companies. Instead, commercialization awards target marginal commercializers: inventors, small businesses, and start-ups that are unable to obtain private funding without some government assistance.[366] Various design features of commercialization awards, in particular reliance on private matching requirements as a signal of value and need, make it possible for government to award only the companies that really need awards while avoiding commercial lemons.

Of course these mechanisms will not be perfect. It is certainly possible that commercialization patents would do a better job of evaluating inventions' near-term commercial potential and spurring innovation. As a compromise, I might ordinarily recommend a "mixed-incentives" model.[367] But the U.S. government has already adopted this bifurcated system for resolving market failures, relying on private markets, relatively broad invention patents, and supplemental public financing for small businesses and entrepreneurs.[368] Therefore I suggest holding back on introducing this unproven legal innovation.[369] Policy analysts and economists such as Lerner, Porter, and Feldman are doing research on improving existing award programs.[370] Legal scholars who know the laws related to IP and innovation policy could assist in these efforts.

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366. *See supra* note 22 and accompanying text.

367. *See, e.g.*, Frischmann, *supra* note 1, at 349–50 (asserting IP should be mixed with other mechanisms).

368. This policy preference has a strong historical basis. Alexander Hamilton supported "exclusive privileges," along with "pecuniary awards," for "new inventions and discoveries" but ultimately rejected his own proposal to the extent that it went beyond patents for inventions under the Patent Act. *See, e.g.*, Camilla Alexandra Hrdy, *Do We Need More IP to Promote Commercialization?*, WRITTEN DESCRIPTION (Mar. 2, 2014, 10:51 PM), http://writtendescription.blogspot.com/2014/03/do-we-need-more-ip-to-promote.html.

369. As mentioned, I am not necessarily opposed to Ouellette's suggestion for introducing commercialization patents in limited regions in order to test the theory. *See* Ouellette, *supra* note 39, at 26–27.

370. *See, e.g.*, FELDMAN & LANAHAN, *supra* note 207, at 1 (exploring the efficacy of state programs); LERNER, BOULEVARD OF BROKEN DREAMS: WHY PUBLIC EFFORTS TO BOOST ENTREPRENEURSHIP AND VENTURE CAPITAL HAVE FAILED AND WHAT TO DO ABOUT IT, *supra* note 37, at 181–90.

APPENDIX: TABLE COMPARING RESPONSES TO COMMERCIALIZATION MARKET FAILURES

Market Failure:	**Commercialization Spillovers**	**Transaction Costs in IP Licensing**	**Capital Constraints**
COMMERCIALIZATION PATENTS	Property rights increase appropriability of investments in new information related to commercialization and facilitate disclosure and transfer	Immunities from injunctions for invention patent infringement (reasonable royalty) *or* Paper patent doctrine (favors commercialized patents)	Protect precontractual disclosures with property rule Opportunity for significant market power increases chance of financing Patent "signals" reduce information asymmetries
COMMERCIALIZATION AWARDS	Government matching of private investment reduces cost and risk of commercializing No new property rights in information	No new legislative solution (but Ebay already makes injunctions conditional; and paper patent doctrine can be introduced without creating new IPR)	Rely on contract and norms to protect disclosures Supply small amount of funding for ESTD[371] and operating capital Government "certifications" reduce information asymmetries

371. ESTD refers to "early-stage technology development," the stage between invention and the point at which a patentable or unpatentable invention has sufficient commercial applications and business potential to attract private financing independent of government support. *See* BRANSCOMB & AUERSWALD, BETWEEN INVENTION AND INNOVATION, *supra* note 14.