COMMERCIALIZATION AWARDS

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The United States has a system of intellectual property rights (IPR) that includes patents for new and nonobvious inventions. Patents are believed to indirectly promote innovation in part by creating incentives to bring inventions to market (i.e. "commercialize") at a faster pace than would otherwise occur. Now, stressing patents' virtues as commercialization incentives, some patent law scholars have proposed introducing entirely new forms of "commercialization patents" based on the theory that this would significantly reduce the risks associated with commercializing inventions and spur socially beneficial innovation and entrepreneurial activity.

Although I agree that various market failures may impede commercialization even in the presence of invention patents, in this Article I show that the United States already has a system for promoting private sector commercialization of inventions that does not require creating new forms of exclusive rights: direct financing for inventors and other entrepreneurs in the early stages of technology development and commercialization. These are sometimes called "commercialization awards." The Article shows that, although they do so in different ways and with varying degrees of success, commercialization awards respond to similar theoretical market failures as commercialization patents: the difficulty of appropriating returns on investments that generate significant new information ex post to invention; transaction costs in IP licensing that can hinder commercialization; and trust and information asymmetries that make it difficult for entrepreneurs to raise capital even in the presence of invention patents.

The Article concludes that although commercialization patents are better at reducing risks associated with spillovers and competitive "free-riding," commercialization awards are better at resolving market failures associated specifically with entrepreneurship. Research suggests awards can be effective at enhancing company survival and facilitate entrepreneurs' ability to raise funding from investors with deeper pockets. While recognizing the limits and risks of "government-set" incentives, the Article asserts that appropriately designed commercialization awards can effectively mobilize what I call "marginal commercializers": those who could not commercialize their inventions without government intervention. Although there is no way to prove that one form of incentive is superior to the other, the Article recommends focusing on improving existing options before introducing an unproven legal innovation in the form of commercialization patents.

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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: i.e. "commercialization."[1] After all, as

[1] This definition of innovation has been associated with economist Joseph Schumpeter and commercialization-focused justifications for patents. *See* Robert Merges, *Commercial Success and Patent Standards: Economic Perspectives on Innovation*, 76 CAL. L. REV. 803, 806-808 (1988) ("An invention refers to the practical implementation of the inventor's idea. This often takes the form of a prototype or model. An invention, then, is more than a concept (it is usually a tangible thing), but less than the fully worked out product or process first offered for sale to customers An innovation is the "debugged" and functional version of the invention: the version first offered for sale.") *See also id.* at 843-46 (explicitly adopting a Schumpeterian framework in patent law despite little prior attention by legal scholars.) *See also* Dan Burk & Mark Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1573 (2003) (stating, in the context of discussing the commercialization incentive of patents, "[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."); Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 738, n. 70 (2012) (same); Michael Burstein, *Exchanging Information Without Intellectual Property*, 91 TEX. L. REV. 227, 237-38 (2012) (discussing Schumpeterian notion of innovation and linking it with patents' "imperative to commercialize.") This definition 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) (arguing that "the conventional view of the patent system as a device that enables an inventor to capture the returns from his investment in the invention" is incomplete and providing a variety of justifications for viewing patents 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.")

Joseph Schumpeter put it "[a]s 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 the information associated with a narrow patent on a new and nonobvious invention, they argue, government neglects significant market failures following invention, 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 "[t[he economic rationale for patent protection for ex ante inventive efforts arguably applies with similar force for ex post commercialization efforts,"[7] they argue Congress should create new or expanded forms of patents specifically targeted at promoting commercialization, sometimes called "commercialization patents."[8] It is not out of the question that Congress will eventually adopt such proposals. At least sixty countries already offer "second tier" patents with lower novelty and nonobviousness 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 these types of "ex post" justifications for exclusive rights, concluding that IP-based incentives to engage in conduct after invention is a

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[2] Joseph Schumpeter, THE THEORY OF ECONOMIC DEVELOPMENT 88–89 (Redvers Opie trans., Harvard Univ. Press 1951).

[3] See Merges, *Commercial Success and Patent Standards*, *supra*, at 809 ("[T]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*, at 341; Michael Abramowicz & John 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.")

[6] Abramowicz & Duffy, *Intellectual Property for Market Experimentation*, *supra*, at 340-41; Sichelman, *supra*, at 352.

[7] Sichelman, *supra*, at 373-74. See also Abramowicz & Duffy, supra, at 340 ("Just as patents encourage risky but ultimately beneficial technological experimentation, some form of intellectual property could result in a socially beneficial levels of market experimentation and entrepreneurial activity.")

[8] Sichelman, *supra*, at 346 (proposing exclusive rights to market "substantially novel" products that have not been commercialized.) An earlier proposal for protecting innovation "*directly*, instead of indirectly," is the "innovation warrant," which could be obtained for anything, not just technology, so long as it is not available in the "ordinary course of trade." The warrant would have a shorter period of exclusivity than an invention patent and would be calibrated based on the risk of investment. The warrant would be "irrevocable," notwithstanding subsequent technological or market developments. Id. at 398-99 (discussing William Kingston, DIRECT PROTECTION OF INNOVATION. KLUWER (1987)).

[9] *See* Sichelman, *supra*, at 397-98 (discussing petty patents, which have relaxed nonobviousness standards, shorter terms, and could potentially be obtained for substantially novel products that do not introduce entirely new technological subject matter.) For instance, Spain's *modelo de utilidad* is a ten year patent granted based on a "relative" novelty standard. Unlike Spanish patents for which absolute novelty is required, the invention simply must not have been disclosed in Spain. *See* Spain: Law No. 11/1986 of March 20, 1986 on Patents, TITLE XIV, Article 143, (for *modelos de utilidad* the "state of the art" is determined with reference to written, oral, or use disclosures *in Spain*.)

[10] For Office of Science and Technology Policy's stated support for entrepreneurs, see http://www.whitehouse.gov/administration/eop/ostp

"strikingly anti-market" policy that removes the discipline of competitive markets.[11] However, to the extent Lemley suggests there is no market failure, many commentators would disagree. Technology policy advocates like Lewis Branscomb and Fred Block suggest that a healthy innovation system requires far more than patents for inventions. Innovation in today's economy also requires capital markets that are responsive to the needs of entrepreneurs[12] attempting to finance ventures involving new and unproven technology.[13] Given the importance of entrepreneurship and external sources of invention to economically significant innovations,[14] there is no reason to think markets modified only by patents will ensure commercialization of all promising inventions, or at least not within a time period most people care about.[15]

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 private markets fail: direct government financing in the form of "commercialization awards": direct financing for inventors, start-ups, and small businesses attempting to develop and commercialize science and technology-based research. Although commercialization awards implicate the risks stressed by advocates of "market-set"[16] innovation incentives – that the government will end up sponsoring lemons the private sector ignores or award companies that didn't need the money anyway – they do not generate the main costs associated with creating new patents that protect more than invention: restricting output below the optimal level and new transaction costs in patent licensing.[17] When seen in this context, ex post incentives for IP such as commercialization patents are *not* "strikingly anti-market," as

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[11] *See* Mark Lemley, *Ex Ante versus Ex Post Justifications for Intellectual Property*, 71 CHI. L. REV. 129, 132 (2004). *See also* Lemley, *The Myth of the Sole Inventor*, supra, at 738-45.

[12] I use the term entrepreneur loosely to mean independent inventors, start-ups, small businesses, and early-stage companies without a significant track record, generally under ten years of age. *See* Stuart Graham, Robert Merges, Pamela Samuelson, & Ted Sichelman, *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 ten years) (citing Sichelman & Graham, *infra*, at 148, n. 118) (adopting definition of entrepreneurs as "those persons central to the formation of new firms," and consequently "focusing on the young company as the unit of analysis.")).

[13] See Philip Auerswald & Lewis Branscomb, BETWEEN INVENTION AND INNOVATION: AN ANALYSIS OF FUNDING FOR EARLY-STAGE TECHNOLOGY DEVELOPMENT, Prepared for Economic Assessment Office, Advanced Technology Program (ATP), National Institute of Standards and Technology (NIST), GCR 02-841 (2002) [hereafter BETWEEN INVENTION AND INNOVATION]; Branscomb & Auerswald, *The Changing Landscape*, in TAKING RISKS: HOW INNOVATORS, EXECUTIVES, AND INVESTORS MANAGE HIGH TECH RISKS 176-78 (eds. Lewis Branscomb & Philip Auerswald, 2002) [hereafter "TAKING RISKS."] *See also* Fred Block, *Innovation and the Invisible Hand of Government,* in STATE OF INNOVATION 1-26 (Fred L. Block & Matthew R. eds. 2010); Block & Matthew Keller, *Where Do Innovations Come From? Transformations in the US Economy, 1970-2006,* Information Technology and Innovation Foundation (2008); 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 U.S. does not have an active technology policy.)

[14] *See* Part II.C.3.

[15] *See* Part II.B-C.

[16] *See* Part III.D.1.

[17] *See* Lemley, *supra*, at 149 (warning against eliminating the "discipline of a competitive market" by giving companies rights to exclude beyond those necessary to induce invention). *See also* Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031, 1058–61 (2005) (summarizing types of costs that an IP can impose on a society).

Lemley concludes.[18] They are the *pro-market* alternative to direct government financing for commercialization of emerging technologies.[19]

The question to be asking is not whether we need incentives to encourage commercialization following invention. As I will show, the government has already decided that we do, identifying a variety of market failures that warrant intervention in markets. Rather, the question for IP scholars to consider is whether new patent-based incentives for commercialization are necessary or desirable in light of existing non-patent alternatives. If the answer turns out to be no, that commercialization awards work reasonably well, then it seems reasonable to conclude that new forms of IPR are not worth the cost. In addressing these issues, I proceed as follows.

I Part I, I lay out the theoretical framework underlying proposals for new IP-based commercialization incentives. In Part I.A, I explain the traditional theoretical models for how patents are said to promote invention and, indirectly, commercialization. In Parts I.B. and I.C., I explain 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 over-arching model. Rather, commercialization theory (or, more accurately, commercialization theories) 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, under-reward commercialization and that new forms of IPR are consequently required. In Part II.A., I explain 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 contain technological subject matter ("commercialization patents.") Although they differ in form, both draw on patent commercialization theories and are based on the assumption that problems arise during commercialization that warrant new patent rights.[20]

As already mentioned, some doubt such market failure exists "ex post" to invention. But in Part II.B., I draw on substantial literature and economic theory suggesting that commercialization itself implicates various market failures.[21] The main market failures identified in Part II.C. 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 technology entrepreneurs in raising capital, even among "high-risk" investors such as venture capital firms.[22] None of

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[18] Lemley, *Ex Ante versus Ex Post Justifications for Intellectual Property, supra*, at 132.

[19] *But see* Lemley, *The Regulatory Turn in IP*, 36 HARV. J. L. & PUB. POL'Y 110, 113-15 (2012) (arguing that IPR regimes, though couched in property rights rhetoric, have become increasingly regulatory, with patents resembling government "permissions" to enter a market.*)*

[20] "IP for market experimentation" applies to "*commercially nonobvious*" innovations (e.g. new business models) that cannot currently be patented, *see* Abramowicz & Duffy, *supra*, at 400-407, 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. The latter may or may not involve any nonobvious commercial information. Sichelman, supra, at 402-403.

[21] In my discussions of possible market failures, I draw on Mankiw's popular economics textbook. *See* N. Gregory Mankiw, PRINCIPLES OF MICROECONOMICS 11-13 (2008, 6th Ed.)

[22] Other market failures not discussed in this article include where commercializing an invention efficiently would require extensive collaboration between private firms, government, and universities or implementation of an industry-wide standard. Such collective action problems are the main justification for the Manufacturing

these market failures is completely eliminated by patents for new inventions. Indeed, they can be exacerbated by them.[23]

Concluding a market failure exists and warrants government action is an inherently political decision over which reasonable people can disagree. But these problems are already cited in government policy as justifying commercialization incentives – just not *patent-based* incentives.[24] As I show in Part III, a variety of financial awards are available at the federal and state levels to help inventors, start-ups, and small businesses commercialize inventions when markets fail.[25] Several state programs refer to these incentives as "Commercialization Awards," a name I adopt. As explained in detail, they take the form of cash, loans, or equity, and their purpose is to accelerate commercialization of applied science and technology-based research. While skeptics of "government-set" incentives may doubt governments' ability to effectively design and administer these programs,[26] if the goal is to effectuate commercialization of inventions that would not otherwise occur, then some evidence suggests they are effective.[27] And at both the national and regional levels, policymakers' consensus on incentives directed at so-called "innovation clusters" has generally been positive.[28] This is in stark contrast to the negative press patents have received of late, with

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Extension Program (MEP), operated by the National Institute of Standards and Technology (NIST.) *See* Wendy Schacht, *Manufacturing Extension Partnership Program: An Overview*, Congressional Research Service, at 1-2, 5 (April 25, 2011.) *See also* Stephen Martin & John Scott, The Nature of Innovation Market Failure and the Design of Public Support for Private Innovation, 29 RESEARCH POLICY 437-447 (2000.)

[23] *See* Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 THE JOURNAL OF ECONOMIC PERSPECTIVES, 29-41 (1991) (asserting that patent incentives for initial creators can impede cumulative innovation.) On the distinct problem of transaction costs see citations in PartII.C.3. *See also* Abramowicz & Duffy, *supra*, at 403 (noting that in cases where a defendant that has infringed an un-worked invention patent "engaged in successful commercialization of a patented product without having a patent's protections against second movers, then the patent cannot be defended as necessary… to encourage commercialization."); Sichelman, *supra*, at 384-85 (discussing inventor-commercializer transaction costs.)

[24] *See, e.g.,* Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, supra, at 1-4 (describing a perceived need for federal and state government funding sources during ESTD).

[25] 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 MICHIGAN JOURNAL OF PRIVATE EQUITY & VENTURE CAPITAL LAW 195, 202-208 (2013). *See also* Bruce Katz & Jennifer Bradley, THE METROPOLITAN REVOLUTION (2013); Edward Glaeser, TRIUMPH OF THE CITY (2011). 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 (Lewis Branscomb, Fumio Kodama, & Richard Florida, eds. 2009.)

[26] See discussion of government-set versus market-set incentives in Part III.D.

[27] See discussion of this evidence in Part III.C.

[28] The government's positive stance is evidenced, for instance, by a recent National Academy of Science (NAS) symposium, where representatives from government, universities, and academics convened to discuss cooperative strategies for promoting innovation in the face of economic downturn. *See* GROWING INNOVATION CLUSTERS FOR AMERICAN PROSPERITY: SUMMARY OF NATIONAL ACADEMY OF SCIENCES SYMPOSIUM ON INNOVATION CLUSTERS AND BEST PRACTICE IN STATE AND REGIONAL INNOVATION INITIATIVES (2009), available at: http://sites.nationalacademies.org/PGA/step/PGA_043846.

commentators complaining patents are harming small businesses and dampening innovation and economic growth.[29]

In Part IV, I draw on IP scholarship surrounding the "patents versus prizes" debate[30] to inform a comparative analysis of newly proposed commercialization patents and existing commercialization awards. After explaining the distinct ways in which each responds to the market failures identified in Part II.C., I argue that which incentive we select depends on which market failure we think is most problematic.[31] Commercialization patents are highly effective at permitting commercial risk-takers to internalize the benefits of their investments in experimentation.[32] Meanwhile, commercialization awards provide a weaker incentive to generate and disclose entirely new information and provide no new mechanism for transferring that information to others. But they more effectively target what I call "marginal commercializers": possessors of patentable or unpatentable inventions who cannot commercialize in the absence of government support.[33] The trick is for government to identify these 'on-the-cusp' entities and avoid giving out public money for purely political reasons or to companies that would have been financed by private investors anyway.[34]

Shifting to the normative, I argue that, despite the risk of some deadweight loss (the deadweight loss of government-set awards[35]), commercialization awards possess the major benefits of commercialization patents – reducing the risk of commercializing inventions – without generating the costs of creating new exclusive rights (e.g., the deadweight loss of market-set patents.[36]) What is more, unlike mere invention and disclosure, commercialization potentially produces *direct economic benefits in the near term*. Thus, it makes sense to ask taxpayers to fund commercialization incentives in order to achieve these spillovers.[37] My goal is not to make an airtight case that commercialization awards are more efficient; I simply suggest they might be. And since we already have awards and don't have commercialization patents, introducing the latter would be ill advised. A better strategy is to follow the advice of researchers and policy analysts trying to improve the structure of existing programs.[38]

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[29] For a recent review of these types of critiques among academics, politicians, and the media, see Ryan Holte, *Patent Trolls or Great American Inventors: Case Studies of Patent Assertion Entities*, 59 ST. LOUIS U. L. REV. (forthcoming 2014.)

[30] For recent legal scholarship comparing patent and non-patent innovation incentives, see Frischmann, *Innovation and Institutions: Rethinking The Economics of U.S. Science and Technology Policy*, supra, at 347; Michael Abramowicz, *Perfecting Patent Prizes*, 56 VAND. L. REV. 115 (2003); Scotchmer, INNOVATION AND INCENTIVES (2004); Amy Kapczynski, *The Cost of Price*, 59 U.C.L.A. L. REV. 970 (2012); Josh Sarnoff, *Government Choices in Innovation Funding (With Reference to Climate Change)*, 62 EMORY L. J. 1087 (2013); Daniel Jacob Hemel & Lisa Larrimore Ouellette, *Beyond the Patents-Prizes Debate*, 92 TEX. L. REV. 303 (2013.)

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

[32] See Part IV.A.

[33] See Part IV.B.

[34] *See* discussion in Part III.D, *infra*.

[35] Deadweight loss occurs when losses to buyers and sellers that result from a tax or a subsidy exceed the revenues raised or the benefits obtained from the subsidy. See Mankiw, supra, at 159.

[36] See Lemley, *Property, Intellectual Property, and Free Riding*, *supra*, at 1058–65 (listing five separate costs of IPR: deadweight loss for consumers, reduced incentives to innovate, rent-seeking, distorted investment in R&D, and costs associated with patent prosecution and litigation.)

[37] See Part IV.B.2.

[38] Based on years of research, Josh Lerner has summarized what he sees as the main downsides of government venture capital programs and provided a variety of recommendations for improvement, including instituting matching requirements. See Lerner, BOULEVARD OF BROKEN DREAMS, supra, at 181-90; Lerner, *Boulevard of*

Importantly, although the 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 that invention patents play a key role in facilitating commercialization of inventions. Commercialization awards supplement patents in this regard; they do not and possibly could not replace them. This is yet another reason not to create new forms of patents that do largely the same thing as patents do already.

I. PATENTS AND COMMERCIALIZATION

Knowledge and information are thought to be public goods that will be under-produced by private markets due to the difficulty of appropriating returns on investment.[39] Many kinds of knowledge and information-producing activities, from speech, to education, to research into new technologies, generate positive externalities – also sometimes called spillovers[40]– for others who did not pay for them.[41] Because the long-term value of these activities to society is far greater than the expected private benefit, economists agree that some form of government response to influence private behavior, whether in the form of

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Broken Dreams: Innovation Policy and Entrepreneurship, in INNOVATION POLICY AND THE ECONOMY 61-81 (Josh Lerner and Scott Stern, eds. 2013).

[39] Public goods are nonrival meaning they can be used by many at once without depletion, and nonexcludable, meaning excluding others is impossible or prohibitively costly. Mankiw, supra, at 219-21. *See also* Joseph Stiglitz, *Knowledge as a Public Good*, *in* GLOBAL PUBLIC GOODS: INTERNATIONAL COOPERATION IN THE 21ST CENTURY 307-24, 308-10 (Inge Kaul et al. eds., 1999) ("[B]ecause returns to some forms of knowledge can to some extent be appropriated there is some degree of nonexcludability knowledge is often thought of as an impure public good"); SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 31 (2004) (applying same analysis to knowledge and "information goods," whose value comes from the information they contain.)

[40] Adam B. Jaffe Manuel Trajtenberg Michael S. Fogarty, *Knowledge Spillovers and Patent Citations: Evidence from a Survey of Inventors*, 90 THE AMERICAN ECONOMIC REVIEW 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 Frischmann & Mark Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 273 (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.); Frischmann, *Spillovers Theory and Its Conceptual Boundaries*, 51 WILLIAM AND MARY L. REV. 801 (2009) (discussing variety of creative activities that produce positive externalities, including speech.) Innovation produces many kinds of spillovers. The main types of spillovers that concern private firms whose business model requires marketing new technology are technology spillovers and market spillovers, defined in Part II.C.1. Spillovers can be immediate, e.g. where one firm directly copies another's invention, or only emerge over time as innovation proceeds in a cumulative fashion, and the inventor is not the firm that develops the socially useful applications. *See, e.g.,* Scotchmer, *Protecting early innovators: should second-generation products be patentable?*, 27 RAND JOURNAL OF ECONOMICS, 322, 322 (1996); Frischmann & Lemley, *Spillovers*, *supra*, at 273-74 (noting that innovation spillovers are conducive to productive re-use and that consumers of information may produce more social surplus than the original creator's activity.) Spillovers can be relatively localized to one region, or they can have a geographic dimension, where knowledge produced in one region "spills over" to another. *See* David Audretsch & Maryann Feldman, *Knowledge Spillovers and the Geography of Innovation,* HANDBOOK OF REGIONAL ECONOMICS 1-39 (May 9, 3003) (reviewing research on the role and significance of geographic knowledge spillovers.)

[41] On positive externalities, generally, including technology spillovers, see Mankiw, supra at 196-202.

direct subsidies or tax breaks, is warranted.[42]

Although there are non-economic justifications for patents,[43] from the utilitarian perspective, patents are viewed as a foundational way for government to support investments in externality-producing new technologies by enhancing firms' ability to capture the economic benefits of their investments.[44] According to most economists, patents may be the best way to do this because they facilitate the task of valuing unproven inventions and avoid the dangers of so-called "industrial policy," where government intervenes in specific industries in the economy.[45]

In the next sections, I introduce traditional models for precisely how patents are believed to resolve problems of under-innovation in the private sector. I then introduce various commercialization theories of patents, starting with Kitch's so-called prospect theory and moving to theories of later scholars that build on (or in some cases significantly diverge from) Kitch to highlight ways that patents incent and facilitate commercialization of inventions.

A. Traditional Justifications For Patents

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[42] *See* Michael Graetz & Rachel Doud, *Technological Innovation, International Competition, and the Challenges of International Income Taxation*, 113 COLUM. L. REV. 348, 348-50 (2013) (noting widespread agreement among economists that technological innovation is important to economic growth but tends to be underprovided by the market in the absence of government incentives and that public support for R&D, such as through tax law, is virtually ubiquitous among nations due to the perception that public returns exceed the private returns.) *See also* Brian Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 73 THE AMERICAN ECONOMIC REVIEW, 691, 691 (1983) (noting that public intervention in the market for research is "virtually universal" and going on to analyze three types of incentive interventions, patents, prizes, and research contracts.) *See also* Mankiw, supra, at 195-209 (discussing positive externalities, including research into new technologies, and appropriate government responses.)

[43] *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* Merges, JUSTIFYING INTELLECTUAL PROPERTY 9-23 (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' theory of distributive justice). *See also* Eric Claeys, *On Cowbells in Rock Anthems (And Property in IP)*, 49 SAN DIEGO L. REV. 3 (2012) (suggesting that IP expresses and internalizes the noneconomic foundations Merges justifies through midlevel mechanisms different from the mechanisms Merges considers).

[44] *See* Scotchmer, INNOVATION AND INCENTIVES, *supra*, 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, at 310 (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.) *See also* Mankiw, supra, at 202 ("[One] way to deal with technology spillovers is patent protection…The patent internalizes the externality by giving the firm a property right over its invention.")

[45] *See* Scotchmer, INNOVATION AND INCENTIVES, *supra*, at 85 ("A virtue of IP as an incentive mechanism is that it decentralized decision making.") *See also* Mankiw, supra, at 202 (comparing patents to "industrial policy" options for confronting externalities and noting economists' skepticism of the latter.) *See also* Kapczynski, supra, at 974-75 (discussing Harold Demsetz's influential 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 this view is "so deeply internalized in the field of IP law that it is taken for granted.") *See also id.* at 983, n. 40 (citing examples in IP scholarship.)

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, patents promote innovation by generating three main types of incentives.[46]

Incentive to invent. First, by giving inventors the opportunity to obtain exclusive rights to make, use, and sell novel and "nonobvious" inventions for twenty 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.[47]

Incentive to disclose. 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.[48]

Indirect incentive to commercialize. 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.[49] That is, by rewarding invention, patents "indirectly" promote commercialization and the introduction of innovations that effect the economy.[50] Patents' indirect pull towards the market was noted by Adam Smith and nineteenth century luminaries like Justice Story.[51]

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[46] Due to the chronological ordering of this part – from traditional theory to Kitch to commercialization theories beyond Kitch– I draw here on Frtiz Machlup's 1958 review of the patent system. *See* Fritz Machlup, *An Economic Review of the Patent System*, SUBCOMM. ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE S. COMM. ON THE JUDICIARY, STUDY NO. 15, 85TH CONG., 2D SESS. 21 (Comm. Print 1958). *See also* 35 USC § 154 (describing contents and term of patent right); § 102 (novelty), § 103 (nonobviousness). Others have framed traditional incentives theory in similar ways. *See, e.g.,* 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 Joseph Shumpeter's and Edmund Kitch's contributions focusing on innovation as including commercialization.)

[47] Machlup, supra, at 21 (describing the "reward by monopoly" justification for patents).

[48] Machlup, supra, at 21 (describing the "exchange-for-secrets" justification for patents). *See also* 35 U.S.C. 112 (a). Whether patent specifications directly "teach" useful information to other innovators is subject to debate; and it is doubtful that the teaching function of patent specifications can be considered the primary function of patents. *See* Lisa Larrimore Ouellette, *Do Patents Disclose Useful Information?,* 25 HARV. J.L. & TECH. 545, 548 (2012) (concluding that patent specifications can but do not always provide useful information to nanoscience researchers). As explained further below, the traditional disclosure model does not account for the informal disclosures that a patent makes possible in the courts of deals surrounding licensing, sale, and/or development of patents and patented inventions. *See* Merges, *A Transactional View of Property Rights*, supra, at 1500.

[49] Machlup, supra, at 21 (describing the "monopoly profit-incentive" feature of patents, which assumes patents are "the simplest, cheapest, and most effective way" "to make it worthwhile for inventors and capitalist backers to make their efforts and risk their money" in "inventions and/or their exploitation.")

[50] See Merges, Commercial Success and Patent Standards, supra, at 809 (asserting, in the Schumpeterian framework, that the "[t]patent system rewards innovation only indirectly, through the granting of patents on inventions.") *See also* Burstein, *supra*, at 237 (discussing the "commercialization imperative" created by patents, also in the Schumpeterian.)

[51] Adam Smith noted the "pricing" virtue of patents, writing that

> if the legislature should appoint pecuniary rewards for the inventors of new machines, etc., they would hardly 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.

ADAM SMITH, Lectures on Jurisprudence 82-83, quoted in ROBERT MERGES & JOHN DUFFY, PATENT LAW AND POLICY: CASES AND MATERIALS 7 n. 20 (2007). *See also* Lowell v. Lewis, 15 Fed. Cas. 1018, 1019

B. Beyond Prospect Theory

Although the notion that patents indirectly promote commercialization by creating exclusive rights in inventions has a strong theoretical and historic 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.[52]

In *The Nature and Function of the Patent System*, Kitch asserted that focusing on a patent as merely a "reward" for invention necessarily provides an "incomplete" view of patents because patents' most important role lies in conferring exclusive rights to develop and commercialize the invention after patenting.[53] Kitch's most discussed proposition in this regard is so-called "prospect theory." 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 rights to develop an invention 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.[54] 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 and/or coordinate with the patent owner.[55]

Scholars like Merges and Richard Nelson, have questioned Kitch's assertion that granting one firm early control over the development of an invention is desirable, particularly in light of transaction costs in IP licensing (discussed in Part II.C.2.) that might reduce the ability of the patent holder to coordinate and cross-license with others in the field.[56] 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.[57] As Nelson put it,

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(C.C.D. Mass. 1817) ("whether [the invention] be more or less useful is a circumstance very material to the interests of the patentee.")

[52] For this point see also, e.g., Sichelman, *Commercializing Patents, supra*, at 374 ("The modern incarnation of these ex post theories of patent law [critiqued by Lemley] began with Ed Kitch's landmark 1977 article, *The Nature and Function of the Patent System*, which introduced the "prospect" theory."); Burstein, *supra*, at 239 (discussing Kitch as laying the groundwork for further scholarship advocating "taking the costs of commercialization into account in setting patent policy.") *See also* Christopher Buccafusco, Zachary Burns, Jeanne Fromer, and Christopher Sprigman, *Experimental Tests of Intellectual Property Laws' Creativity Thresholds*, 93 TEX. L. REV. 1921, 1925, 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.)

[53] *See* Kitch, supra, at 266 ("The reward theory is not questioned on its own terms. Rather, it is argued that the reward theory often offers an incomplete view of the function of the patent system.")

[54] Kitch, supra, at 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, e.g., id. at 283-84 (suggesting that efficiency of unification of control and pioneer patents allow a more efficient research strategy.)

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

[56] Robert Merges & Richard Nelson, *On the Complex Economics of Patent Scope*, 90 Col. L. Rev. 839, 873-74 (1990).

[57] Id.

> a broad initial patent that gives monopoly rights to exploration of the prospect 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 with the holder of the original prospect defining patent.[58]

In a similar vein, Lemley and Dan Burk criticized prospect theory on the ground that it is linked to a Schumpeterian view of innovation, in which it is assumed the cost of research and true innovation necessitates large firms rather than small firms operating in competitive markets. "On this view," they write, "only strong rights to preclude competition will effectively encourage innovation."[59]

Some suggest 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.[60] 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.[61] A close reading of Kitch's article reveals several distinct ways in which he believed patents commercialization. All are important for thinking about how patents might incentivize and facilitate commercialization, and have appeared in later scholarly debates.

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."[62] This incentive to commercialize may be indistinguishable from the "indirect" incentive noted above,[63] 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 towards

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[58] *See* Nelson & Robert Mazzoleni, *Economic Theories About the Costs and Benefits of Patents*, 32 J. Economic Issues, 1031, 1033-40 (1998.) Notably, Nelson does *not* critique "development and commercialization theory," which he treats separately from prospect theory. *See id.* at 1032-40. [[The page numbers in Nelson and Mazzoleni may be off.]]

[59] See Burk & Lemley, Dan L. Burk & Mark A. Lemley, THE PATENT CRISIS AND HOW COURTS CAN SOLVE IT 128 (2009.) See also Merges, supra, at 843 (discussing Schumpeter's rejection of "an industry structure that encourages competition among many small firms" because the "expense of conducting research" implies that "large firms are necessary to keep the engine of capitalist change [produced by technological innovation] going.")

[60] *See, e.g.,* Burk & Lemley, *supra*, at 128 (associating Kitch with Schumpter.)

[61] *See* Sichelman, *Markets for Patent Scope*, 1 IP THEORY 42 (2010) (arguing that critiques of Kitch's theory focus on Kitch's assumption that broad, early rights efficiently allocate resources towards different innovations and "mostly ignore Kitch's concerns about commercialization.") *See also* Stephen Yelderman, *Coordination-Focused Patent Policy*, (working paper, 2014), at 11 ("Although Kitch noted a variety of ways that the patent system could increase the output from resources used for technological innovation, subsequent commentators have tended to discuss them all under the broad rubric of "prospect" (or sometimes "commercialization") theory, and have not consistently distinguished among these various, alternative uses of the patent system.")

[62] Kitch, supra, at 276.

[63] *See* Hemel & Ouellette, supra, at 360-61 ("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.")

innovations likely to yield profits in the presence of patents and away from socially valuable innovations that patents (and markets themselves) do not reward.[64]

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.[65] 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 patents are not necessarily required for exchanging information effectively.[66] Relatedly, Kitch suggested that patents can reduce the cost of preventing leaks *within the firm*.[67] This is also debated, with scholars like Lemley suggesting trade secret laws do a better job at reducing the cost of preventing leaks.[68]

Avoid distortion of innovation. Lastly, Kitch noted that patents may avoid over-investment in process inventions that are easier to keep secret.[69] The suggestion that investments would go towards process inventions rather than products in the absence of patents has some support in economic history.[70] 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.[71]

C. Commercialization Theory 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

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[64] *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* (working paper 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.)

[65] Id. supra, at 277 ("a patent system lowers the cost for the owner of technological information contracting with other firms possessing complimentary information and resources.")

[66] *See* Burstein, *supra*, at 231-32 (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 patents or trade secret laws more efficiently achieve information exchange. *See* Michael Risch, *Why Do We Have Trade Secrets?* 11 MARQUETTE INTELLECTUAL PROPERTY L. REV. 1, 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.")

[67] Kitch, supra, at at 279 ("Resources devoted to keeping the technology secret are saved.")

[68] Trade secret laws are another way to lower the cost of leaks. *See* Lemley, *The Surprising Virtues of Treating Trade Secrets as IP Rights*, 61, STAN, L. REV. 311, 338, 351 (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 has been subject to "reasonable" efforts to keep it secret.

[69] Id. at 279 ("A patent system covering all the useful arts provides a uniform structure of incentives without regard to the possibility of economic exploitation in secret. Trade secrets create special incentives for processes that can be efficiently practiced in secrecy by a single firm.")

[70] *See* Petra Moser, *How Do Patent Laws Influence Innovation? Evidence From Nineteenth-Century World Fairs*, NATIONAL BUREAU OF ECONOMIC RESEARCH WORKING, Paper No. 9909 (2003) (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.)

[71] See Kapczynski & Sayed, supra, at 1905.

or make the process of commercializing inventions more efficient.[72] None necessarily turns on the importance of broad, early patents held by single firms and some directly contradict prospect theory's assumptions. I discus each development and important critiques below.

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,[73] but provides a more specific reason for this: the significant informational component of commercialization itself.[74] Investments in post-invention activities – such as developing commercial applications, raising capital, production, distribution, market testing, and marketing – all produce information that may benefit second movers who did not make the investments. In other words, commercialization, like invention, produces spillovers that are vulnerable to competitive free-riding.[75] The emphasis on post-invention spillovers does not 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.[76] As discussed further in Part II, skeptics like Lemley and Brett Frischmann disagree that spillovers post invention should be contained, suggesting that full internalization of spillovers is not necessary to optimize investment in innovation, and that the cure of creating more IPR is worse than the alleged problem.[77]

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 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.[78] But this takes

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[72] For Michael Bustein's recent discussion of post-Kitch scholarly developments in commercialization theory, see Burstein, supra, at 239-45.

[73] Kitch, supra, at 276.

[74] For a development of this theoretical framework, see Duffy, *Reviving the Paper Patent Doctrine*, 98 CORNELL L. REV. 1359 (2013) (proposing reviving a doctrine that discounts non-worked patents in favor of worked patents because commercialization entails far more risk and information production than a patent alone.)

[75] This focus on free-riding on post-invention efforts is evidenced in the writings of various scholars since Kitch despite their different theoretical takes. *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 IP.) *See also* Kieff, *infra*, at 708 (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[.]") *See also* Abramowicz & Duffy, IP for Market Experimentation, supra, at 337-40 (discussing the risk of under-investment in commercially nonobvious innovations due to the risk of free-riding); Sichelman, *Commercializing Patents*, supra, at 372-77 (discussing the risk free-riding on first movers' investments and arguing this contributes to an "under-commercialization" problem.)

[76] See, e.g., Kitch, supra, at 276.

[77] See, e.g., Lemley, *Property, IP, and Free Riding*, *supra*, at 1032 (discussing introduction of property's free riding "rhetoric" in IP over-emphasis on containment of spillovers); Frischmann & Lemley, supra, at 257-58 (questioning whether complete internalization of externalities is necessary to optimize investment incentives.)

[78] For 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 140-83 (eds. B. Smith & C. Barfield, 1996.) Hall discusses studies measuring private returns from doing R&D within the firm id. at 145-48, private returns to public R&D performed with federal funding within firms or in universities and government labs, id. at 149-55, and the effects of basic science research on industrial and commercial innovation (i.e. "the social returns of academic research"), see id. at 155-59.

time.[79] Patent scholars like Duffy, Abramowicz, and T.J. Chiang argue that patents may accelerate the pace at which innovation occurs.[80] As Chiang puts it, "the 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."[81] Paying monopoly prices for a period of years is better than having no access at all to a socially valuable innovation.[82] Duffy provides a mechanism through which patents accomplish this acceleration effect through racing.[83]

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.[84] The "transactional role" of patents has been developed significantly since Kitch in work by Robert Merges[85] and Scott Kieff,[86] who argue that one of the key functions of patents is that, like other property rights,

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[79] Id. at 156-58 (citing studies suggesting that 1/10 products and processes would not be developed without recent academic research and that it takes on the order of 7-10 years for this research to effect commercial applications.)

[80] Duffy, *Rethinking the Prospect Theory of Patents*, *infra*, at 443-49. *See also* Michael Abramowicz & Duffy, *The Inducement Standard of Patentability*, 120 Yale L.J. 1590, 1599 (noting that a "growing body of literature … views the patent system as attempting not so much to increase but to accelerate innovation.") *See also* Tun-Jen Chiang, *A Cost-Benefit Approach to Patent Obviousness*, 82 S.J. L. REV. 39, 57-58 (2006) ("while 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.")

[81] Chiang, supra, at 42.

[82] Id. at 41-42 (using the hypothetical example of a cure for AIDS.)

[83] 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. 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* John Duffy, *Rethinking the Prospect Theory of Patents*, 71 U. CHI. L. REV. 439, 443-44, 464-75 (2004). For recent discussion of Duffy's critique of Kitch, see also Hemel & Ouellette, *supra*, at 360-61.

[84] See Kitch, supra, 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.") For a recent attempt at new theoretical account of the "coordination function" of patents, see Yelderman, supra, at 6.

[85] Although Merges' work discussing the transactional value of patents is highly relevant to the value of patents for promoting commercialization, I do not consider Merges a "commercialization theorist," and he is not a proponent of prospect theory. Unlike Kitch, Merges assumes patent rights' major benefit lies in facilitating transactions and collaboration among *disperse actors*, not management by a single party. As discussed in PartII.C.2., the major problems that arise in this framework are over-broad patents and, even more so, transaction costs that limit patent licensing. *See, e.g*, Merges & Nelson, *On the Complex Economics of Patent Scope*, *supra*, 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, *The Inducement Standard of Patentability, supra*, at 1599. 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*, 7 HIGH TECH. L.J. 1 1992.)

[86] 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* Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. LAW

they facilitate the disclosure and/or transfer of information related to an innovation from those who generate it to those who can most efficiently develop and use it.[87] Patents' transactional role is highly relevant to debates over non-practicing entities (NPEs), so-called patent trolls, whose primary business model is acquiring, licensing, and enforcing patents generated by others.[88] 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.[89]

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.[90] 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.[91] As discussed in Part II.C.2, the extent to which this theory 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.[92]

A related argument, raised by scholars like Sichelman and Sean O'Connor, is that new or young companies that hold patents can achieve competitive advantage over better-capitalized and better-networked incumbents, serving as "slingshots" that propel entrepreneurs into the marketplace against the Goliaths.[93]

REVIEW, 697, 705, n. 27, 707, n. 47 (2001) (noting the relation to Kitch's prospect theory.) *See also* Kieff, ON THE ECONOMICS OF PATENT LAW AND POLICY: A HANDBOOK OF CONTEMPORARY RESEARCH 3 (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.")

87 Merges, A Transactional View of Property Rights, supra, at 1481-82 (discussing the relevance of Harold Demsetz and property theory to patent law) (citing *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 351-53.)) See also Kieff, *Property Rights and Property Rules for Commercializing Inventions*, *supra*, at 703 ("the 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.")

88 *See* Risch, *Patent Troll Myths*, 42 Seton Hall L. Rev. 457 (2012) (challenging much of the conventional wisdom about "trolls" and non-practicing plaintiffs in general); Risch, *Licensing Acquired Patents*, supra (discussing various theories about the commercialization benefits of patent licensing by both commercializers and NPEs). *See also* Lemley & 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.)

89 See discussion of Coase and transaction costs in PartII.C.2.

90 *See* Kitch, *supra*, at 277 (noting patents facilitate getting financing by permitting disclosure.); Merges, *A Transactional View of Property Rights, supra*, at 1505-1513.

91 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 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 of VC financing and VCs' "love-hate relationship" with patents.)

92 *See* Graham et al, supra, at 1263 (finding that many of entrepreneurs' motivations in patenting have "little to do with the classical incentives and free rider stories[.]") See also id. at 1285 (reporting on weak incentive value of patents.)

93 *See* theoretical discussion of the important role of patents for entrepreneurs in Graham et al, *supra*, at 1258. *See also* Sichelman & Stuart Graham, *Patenting by Entrepreneurs: An Empirical Study*, 17 Mich. Telecom. L. Rev. 111, 112-20 (2010). For the slingshot metaphor, see Sichelman & Sean O'Connor, *Patents As Promoters of Competition: The Guild Origins of Patent Law in the Venetian Republic*, 49 SAN DIEGO L. REV. (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,

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.[94] It was also influential in informing Congress' 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."[95] Indeed, the commercialization 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.[96] Since its enactment, U.S. universities have created technology transfer offices to facilitate the licensing of university inventions to the corporate sector for commercialization.[97]

Now, 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 of technology and spur market activity and entrepreneurship.[98] 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

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serving as a slingshot for the "Davids" against the "Goliaths.")

[94] *See, e.g.*, W. Nicholson Price, *Making Do in Making Drugs: Innovation Policy and Pharmaceutical Manufacturing*, BOSTON COLLEGE L. REV. (forthcoming 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 for IP, supra, at 141.

[95] Rebecca Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663, 1669 (1996) (explaining that advocates of Bayh Dole and allowing patenting of federally funded research "set aside as secondary the standard justification for patents as an ex ante incentive to make new inventions, and shift the focus from the initial costs of making an invention to the subsequent costs of developing an existing invention into a commercial product.") On patent-mediated technology transfer, see Peter Lee, *Transcending the Tacit Dimension: Patents, Relationships, and Organizational Integration in Technology Transfer*, 100 CAL. L. REV. 1503 (2012.)

[96] Eisenberg, *Public Research*, supra, at 1663-65 (discussing policy behind Bayh Dole Act and SBIR to use patents to promote generation of applied research, encourage private investment, and transfer research into the market.)

[97] D. Mowery & B. Sampat, The bayh-dole act of 1980 and university dindustry technology transfer: A model for other OECD governments? *Journal of Technology Transfer. 30(1-2)*, 115–127 (2005.) See also Brian Wright, Industry-Funded Academic Inventions, 507 NATURE, 297, 298 (2014) (finding over 20 years at nine campuses and three national laboratories administered by the UC system, that corporate-sponsored inventions are licensed and cited more often than federally sponsored ones.)

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

The argument for new patent-based commercialization incentives rests on the theoretical, if not fully empirical,[99] 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.

1. Patents for Market Experimentation

In their influential article, *IP for Market Experimentation*, Michael Abramowicz and John 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 has uncertain prospects for commercial success."[100] 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.[101]

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,[102] or entering a new geographic market, such as by opening an Ethiopian restaurant in a location which has none.[103] 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.[104]

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 "new and commercially nonobvious" and vulnerable to free-riding by others.[105] 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.[106]

2. Commercialization Patents

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[99] See Abramowicz & Duffy, supra, 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, 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.")

[100] Abramowicz & Duffy, supra, at 339, n. 4.

[101] Id. at 341 (comparing spillovers from market experimentation to spillovers from technological experimentation).

[102] Id. at 366-67.

[103] Id. at 376-78.

[104] Id. at 342.

[105] *See id.* at 406-408.

[106] *See id.* at 406-407.

In *Commercializing Patents*, Ted 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.[107]

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.[108] But unlike Kitch, Sichelman argues that this narrow focus is one reason so few patents are actually commercialized. Noting that "about half, probably more" of all patented inventions are never commercialized, Sichelman argues the reason is not that these inventions lack value.[109] 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.[110]

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[111] historic precedent in U.S. patent law: a separate form of "commercialization patent" administered by the Patent Office alongside invention patents.[112] 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.[113] Notably, unlike Abramowicz and Duffy's proposals, Sichelman's commercialization patents would be limited to traditional technological subject matter and could not be obtained for merely "commercially nonobvious" innovations such as the Ethiopian restaurant.[114] Second, commercialization patents would have shorter-term lengths than regular patents.[115] Third, they would trigger an affirmative duty to commercialize within that time (i.e. a working requirement.)[116] Fourth, if one or more invention patents related to the product have previously been patented, a commercialization patent could not be

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[107] Sichelman, *Commercializing Patents*, *supra*, at 341 (noting that many U.S. patents are never commercialized).
[108] Sichelman, supra, 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.")
[109] Id. at 343.
[110] *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.")
[111] *But see id.* at 397-400 (discussing existing and proposed options, such as petty patents and innovation warrants, that closely resemble commercialization patents).
[112] Id. at 402-403 (noting the Patent Office would maintain an online commercialization patent database alongside the existing patent database.)
[113] Id. at 346, 400-404. Id. at 401 ("Like patentable subject matter, the disclosure and claiming requirements should mostly track the existing requirements for invention patents, with a few important glosses.")
[114] Id. at 400-401. Sichelman does not recommend extending patentable subject matter to include commercial nonobviousness, instead limiting his proposal to the same types of subject matter that are currently patentable. Sichelman, *Commercializing Patents*, supra, at 396-97 (suggesting allowing patents for market innovations would require too much discretion by the PTO to determine commercial nonobviousness).
[115] Id. at 408-409.
[116] Id. at 402 ("there would be a working requirement," with a time period of perhaps three to five years from filing in which to commercialize.)

obtained until the invention patent/s have gone un-commercialized for at least three years.[117] After that time, the commercialization patent would impart limited immunity from injunctive relief from suits by holders of invention patents.[118] Instead, the commercialization patent holder would have to pay a reasonable royalty fee of around 1-2%.[119]

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, many commentators have objected to patent commercialization theory, though not necessarily using this name. In an influential article, Lemley coined the phrase "ex post justifications" for IP to describe prospect theory and other IP theories that "endorse a greater and perhaps unlimited duration and scope of [patents and copyrights]" on the view that this is the best way to ensure that innovation is "managed efficiently."[120] In Lemley's view, patents that do more than reward generation and disclosure of inventions are both *unnecessary* – "we don't normally need supracompetitive returns or the prospect of exclusivity just to encourage someone to take an existing invention to market"[121] – and *destructive* because they remove "the discipline of a competitive market" for evaluating the commercial merit of an invention.[122] This leads to less efficient outcomes than if companies were forced to develop and market inventions in competition with one other.[123]

By this logic, new forms of IPR that extend into commercialization would indeed make very little sense. If inventors fail to commercialize their even in the presence of patent rights for new and nonobvious inventions – which in Lemley's view are already over-broad in some industries[124] – this must be because their inventions lack technological or commercial merit and cannot survive in the presence of superior substitutes and free entry. We might go on to conclude that, like ex post justifications for IP generally, commercialization patents are "strikingly anti-market arguments" and the result of unproductive rent-seeking.[125]

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117 Id. at 346.

118 Id. at 406-407 ("the commercialization patent would provide immunity from injunctive relief from suits for patent infringement" and require only a reasonable royalty as damages of around 1-2%.)

119 Id.

Id. Id. at 130-32. As explained in Part I, collapsing commercialization theory into prospect theory is inaccurate. In any case, Lemley objects to prospect theory's assumption that an initial inventor with a broad patent is well suited to manage subsequent research and development efforts, *see* Lemley, *Ex Ante versus Ex Post Justifications for Intellectual Property, supra*, at 140, though he does think prospect theory is useful for explaining the role of patents in the pharmaceutical industry. Id. at 141.

121 Lemley, Myth of the Sole Inventor, supra, at 739 (citing Hayek.) See also Lemley, *Ex Ante versus Ex Post Justifications for Intellectual Property*, supra, at 135-36 (using paper clips example to illustrate this point.)

122 Lemley, *Ex Ante versus Ex Post Justifications for Intellectual Property*, supra, at 149.

123 *See id.* ("we give up the very discipline that guarantees us the decisions will be the right ones.")

124 *Id.* On Lemley's views on overbroad and poor quality patents, see, e.g., Burk & Lemley, PATENT CRISIS, supra, at 30-31; Lemley, *Software Patents and the Return of Functional Claiming*, 303 WIS. L. REV. 906, 906-07 (2012) ("It is broad functional claiming of software inventions that is arguably responsible for most of the well-recognized problems with software patents.")

125 *See* Lemley, *Ex Ante versus Ex Post Justifications for IP*, *supra*, at 129.

However, whether IP (or any other incentive) is necessary to protect ex post investments in commercialization is not the threshold question. Rather, we first need to know whether government should intervene in commercialization markets at all. According to neoclassical economic theory, the government's role should be limited to enforcing the rules and maintaining the institutions of a market economy.[126] Government can play a role in improving market outcomes either to promote efficiency in situations where "the market left on its own fails to allocate resources efficiently" (i.e. market failure) or in order to promote equality.[127]

What constitutes an "efficient" level of investment in innovation, let alone a socially acceptable level of inequality, is up for debate. But to the extent Lemley suggests there is no market failure, many commentators disagree.[128] In the next section I draw on IP scholarship and literature on U.S. technology policy by prominent commentators such as Branscomb and Block, suggesting various market failures exist during commercialization of inventions, *including but not limited to appropriation risks*, and that these market failures are particularly prominent for new and small companies. Accordingly, there is no inherent reason to reject commercialization patents on the ground that there is no market failure.

C. Identifying Commercialization Market Failures

In the United States, many sources of private investment are available for technology ventures, including large corporations, venture capital firms (VCs), and angel investors.[129] The main reason such 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.[130] The sources of this risk and uncertainty are numerous.[131] 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. Commercialization Spillovers

The most oft-discussed form of market failure in the IP and economics literature is the risk that investors may be unable to capture the benefits of new information that is not protected by patents or some other form of exclusionary right. As explained above, given the high social value of innovation, intervention in the form of patents of direct subsidy is

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[126] Mankiw, supra, at 11-13.
[127] Mankiw, supra, at 12-13.
[128] Lemley, *Ex Ante versus Ex Post Justifications for IP*, *supra.* 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, he does not necessarily argue there is no market failure, only that IP is not worth the cost. Id. at 135-36. *See also* Lemley, *The Myth of the Sole Inventor*, *supra*, at 740.
[129] Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, supra, at 3-4, 42-51. For recent analysis of the role of VC and angel investing in technology start ups, see Ibrahim, supra, at 733-36 (private venture capital), 738-53 (angel investors).
[130] Branscomb & Auerswald, *Between Invention and Innovation*, in TAKING RISKS, supra, at 9 (discussing the crucial role of profit, risk, and uncertainty in private investors' motivations to invest high technology ventures.)
[131] *See, e.g.,* Frischmann, supra, at 363 (noting that "[t]he presence of risk leads to inefficient investment in innovation for a number of reasons.")

thought to be justified.[132]

Positive externalities from innovation include so-called "technology spillovers," defined as "the impact of one firm's research and production efforts on other firms' access to technological advance."[133] The government can help companies internalize these externalities and give them greater incentives to engage in research and technological advance by granting narrow exclusive rights over new inventions that expire after a certain period.[134] But, as Abramowicz and Duffy observe, positive externalities of innovation are not limited to information produced as a result of technological experimentation.[135] Rather, market failures can arise due to both "technology spillovers (other firms benefit from the investing firm's R&D effort)" and "market spillovers (new products stimulate creative dislocations in existing markets)."[136] Like technological experimentation, this raises the risk of investing in such externality-producing activities and potentially warrants government intervention in the form of IP or more "active" technology policy.[137]

Distinguishing technology spillovers from market spillovers is difficult.[138] 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 made available for purchase.[139] 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[.]"[140]

Obviously, whether we think any of these spillovers warrants new IPR can be debated, and indeed has been debated in the history of American patent law.[141] Lemley may

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132 Mankiw, supra, at 200-202. See also discussion at the start of Part I, supra.

133 Id. at 201.

134 See Mankiw, supra, 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.")

135 Abramowicz & Duffy, *IP for Market Experimentation*, *supra*, at 346-47 (observing that "free market economists have 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.")

136 *See* Branscomb & Auerswald, Overcoming Barriers, in TAKING TECHNOLOGICAL RISKS, supra, at 139, n. 1. See also Frischmann, supra, at 363 (noting that appropriation risks "arise from exclusionary difficulties associated with the public goods nature of innovation and from market response risk.")

137 *See* Branscomb & Auerswald, Overcoming Barriers, in TAKING TECHNOLOGICAL RISKS, supra, at 139 (noting that both types of spillovers are commonly "invoked [by economists and policy analysts] in defense of an active federal technology policy.")

138 Branscomb & Auerswald, *The Changing Landscape*, in TAKING RISKS, *surpa*, 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.)

139 See, e.g., id. at 171; Abramowicz & Duffy, supra, at 339, n. 4 (distinguishing technological experimentation that could occur in a laboratory to test feasibility as a matter of science and engineering and market experimentation, the "commercial test of product or service that is new to the market in which it is launch and that has uncertain prospects for commercial success.")

140 Sichelman, supra, at 354.

141 Alexander Hamilton believed patents should be available for imported inventions to encourage risk taking in manufacturing, but his proposal was ultimately rejected, apparently due to perceptions that the IP Clause and the Patent Act forbade such patents. See Hrdy 28 Berkeley Tech. L. J. at 56, 75 (citing ALEXANDER HAMILTON , REPORT ON MANUFACTURERS (1791); Edward Walterscheid, Patents and Manufacturing in the Early Republic , 80 J. PAT . & TRADEMARK OFF . SOC 'Y 855, 860–78 (1998).) Notably, Hamilton also recommended prizes for imported inventions along with exclusive rights. See Hrdy Local Commercialization Incentives, BALKINIZATION, March 11, 2014 (discussing Hamilton's proposal for

be right that introducing more patent rights to contain new forms of spillovers isn't a "measured" response to market failure.[142] The point is simply that, once we take a broader view of spillovers and risk associated with competitive free-riding, it is apparent that far more information will be produced during commercialization than is fully protected by patents on inventions. This information includes: patented information released through formal disclosures[143]; information released through product sales that benefits others who do not pay for the products[144]; valuable information respecting market demand that is released upon entering a new market[145]; and information released by employees through leaks or when fully-trained employees are hired by a competitor.[146] In any of these cases, the difficulty of appropriating returns increases the risk of investment, reduces the expectation of profit, and reduces the quantity of innovation produced, potentially below the socially optimal level.[147]

2. Transaction Costs in IPR Licensing

As just explained, the main justification for new patents to promote commercialization of inventions is that current IPR regimes do not provide would-be commercializers with enough protection from free-riding during commercialization.[148] However, as emphasized by scholars like Suzanne Scotchmer, creating incentives for innovation is a two-sided enterprise: when IPR regimes reward creators by allowing them to internalize spillovers, this can limit incentives for "cumulative" innovation[149] and "productive re-uses" of information by others.[150]

This has implications for commercialization theory as well. Although the 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

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prizes versus only exclusive privileges for importation), http://balkin.blogspot.com/2014/03/local-commercialization-incentives.html

142 *See* Lemley, *Ex Ante versus Ex Post Justifications for IP*, *supra*, at 149.

143 See, e.g., Frischmann & Lemley, supra, at 133 (noting spillovers related to patent disclosures and patent expiration.)

144 On spillovers and "cross-subsidization" during product sales, see Hemel & Ouellette, supra, at 346-47 (citing Frischmann, INFRASTRUCTURE: THE SOCIAL VALUE OF SHARED RESOURCES 111 (2012)).

145 See Abramowicz & Duffy, supra, at 340.

146 *See* Orly Lobel, TALENT WANTS TO BE FREE: WHY WE SHOULD LEARN TO LOVE LEAKS, RAIDS, AND FREE-RIDING 117 (2013) (observing that just as patent documents produce "positive knowledge spillovers," information possessed by employees can generate "stored and hidden" knowledge that potentially justifies some form of protection in the form of, e.g, trade secret law.) Trade secret laws and contracts that prevent cross-hiring help internalize some employee spillovers. *See, e.g., id.* at 109-114 (discussing incremental broadening of control over company information through expansion of trade secret laws, confidentiality agreements, and noncompetes.)

147 See, e.g. Branscomb & Auerswald, *Overcoming Barriers*, in TAKING RISKS, *supra*, at 139, n. 2 (citing empirical research by economists like Mansfield, Nelson, and Arrow suggesting a divergence between private and public returns from innovation.)

148 See, e.g., Sichelman, supra, at 373-74 (discussing the need for IP to protect information generated during the post-invention commercialization phase due to the problem of free-riding on first-movers in commercialization.)

149 See Scotchmer, *Standing on the Shoulders of Giants*, *supra*, at 30-31.

150 See Frischmann & Lemley, supra, at 257-58 (emphasizing that over-containment of innovation spillovers can be detrimental because innovation is conducive to "productive re-uses.")

through.[151] Thus, "over-rewarding IPR regimes" can be described as a source of market failure that potentially justifies intervention in markets.[152]

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. 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.[153] However, patent scholars such as Merges have highlighted the significant potential for transaction costs in IPR licensing, perhaps more than in real property contexts.[154] 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 invention as opposed to later developments.[155] Additionally, scholars such as Michael Heller have emphasized theoretical difficulties in obtaining rights to practice innovations that trigger multiple overlapping patents ("patent thickets"),[156] 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).[157] When transaction costs are

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[151] See id. See also Branscomb & Auerswald, Overcoming Barriers, in TAKING RISKS, supra, at 139, n. 1 (noting that one of the market failures that can be invoked in favor of an active technology policy is the existence of an IPR regime that rewards innovating firms "excessively (stifling innovation in subsequent product "generations.")

[152] See Branscomb & Auerswald, *Overcoming Barriers*, in TAKING RISKS, *supra*, at 139, n. 1 (noting that another form of innovation market failure is "IPR 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 139, n. 2 (citing empirical work.) On the theoretical problem of rent dissipation in innovation racing, see 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.)

[153] *See* Ronald Coase, *The Problem of Social Cost*, 3 THE JOURNAL OF LAW AND ECON 1, 15 (1960) (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, at 210-12.

[154] See Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 61 TENN. L. REV. (1994) (discussing various kinds of break down in patent licensing that can occur between the holder of an original patent and the holder of a related improvement patent); Merges, *Of Property Rules, Coase, and Intellectual Property*, 94 COLUM. L. REV. 2654, 2654-60 (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.)

[155] Merges, *Of Property Rules, Coase, and Intellectual Property, supra*, at 2655. *See also* Richard Posner, *Intellectual Property: The Law and Economics Approach*, 19 JOURNAL OF ECONOMIC PERSPECTIVES, 57–73 (2005) (discussing transaction costs in IP licensing including holdouts and limited information regarding ownership.)

[156] See Michel Heller & Rebecca Eisenberg, Michael Heller & Rebecca Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 Science 698, 701 (1998) (discussing 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 JOURNAL OF COMPETITION LAW & ECONOMICS 827-58 (2013) (debating the existence of thickets and hold-ups in the real world.)

[157] 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). *See also* Ben Depoorter, *Property Rules, Liability Rules and Patent Market Failure*, 1 ERASMUS L. REV. 67-71 (2008) (discussing effects of innovation uncertainty and

high, private bargaining may break down, potentially warranting intervention through the court system or legislation.[158]

3. Trust and Information Asymmetries in Entrepreneurial Financing

Supporting inventors, technology start-ups, and small businesses (entrepreneurs[159]) is a goal of U.S. technology policy.[160] Such entrepreneurs are believed to be particularly innovative and an important source of long-term economic growth.[161] In addition to innovating at higher rates, once entrepreneurs gain experience and training, they provide a valuable source of talent to go towards future projects ("human capital").[162] This leads to more innovation overall and produces immediate economic benefits for communities in which innovation occurs, such as hiring of local workers, wage increases, and localized knowledge-sharing.[163] Indeed, according to Edward Glaeser and William Kerr's influential 2010 study of U.S. metropolitan regions, "regional economic growth is highly correlated with the presence of many small, entrepreneurial employers—not a few big ones."[164]

Yet several markets failures are specifically associated with high technology entrepreneurship that may make it appropriate for government to respond with incentives to

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uncertain patent boundaries on patent licensing.) *But see, e.g.,* Einder Elhauge, DO PATENT HOLDUP AND ROYALTY STACKING LEAD TO SYSTEMATICALLY EXCESSIVE ROYALTIES?, 4 JOURNAL OF COMPETITION LAW, 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.) *See also* Gupta, *supra*, at 827-58 (disputing the existence and prevalence of hold-ups.)

158 *See* Ebay v. Merc Exchange, LLC, 547 U.S. 388, 396-97 (2006) (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 Epstein & Scott Kieff, *Questioning the Frequency and Wisdom of Compulsory Licensing for Pharmaceutical Patents*, 78 U. CHI. L. REV. 71, 85-92 (2011).

159 Again, I use the term entrepreneur loosely to mean independent inventors, start-ups, small businesses, and early-stage companies without a significant track record, generally under ten years of age. *See* Graham, et al, supra, at 1266-67.

160 On the White House's stated support for start-ups and entrepreneurs, see http://www.whitehouse.gov/economy/business/startup-america

161 For recent statistics on the economic importance of small businesses and SBIR innovators, see U.S. Census Bureau and Bureau of Labor Statistics, available at http://www.sba.gov See also Albert N. Link & John T. Scott, EMPLOYMENT GROWTH FROM THE SUPPORT OF INNOVATION IN SMALL FIRMS, Upjohn Institute for Employment Research (2012.) *See also* Graham *et al, supra*, at 1258, n. 1. *See also* Sichelman & Graham, *supra*, 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.") *See also* Ashish Arora, Wesley M. Cohen, John P. Walsh, *The Acquisition and Commercialization of Invention in American Manufacturing: Incidence and Impact*, NBER Working Paper No. 20264, Issued in June 2014, http://www.nber.org/papers/w20264 (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.)

162 Lobel, supra, at 7 (concluding that laws and policies that restrict worker mobility and knowledge transfer among firms, such as patents and non-competes, will ultimately be harmful for innovation-intensive industries.)

163 *See* Graetz & Doud, supra, at 258-59. On localized benefits, see, e.g., Cable, supra, at 222-25 (explaining justification given for city venture development funds.)

164 Edward Glaeser & William Kerr, The Secret to Job Growth: Think Small, Harvard Business Review, July 1010, http://hbr.org/2010/07/the-secret-to-job-growth-think-small/ar/1 (finding cities whose number of "firms per worker" was 10% higher than the average in 1977 experienced 9% faster employment growth between 1977 and 2000, hypothesizing that large corporations often generate little employment growth even when profitable.)

bridge the gap between private and social returns. The first potential source of market failure to mention, though to not dwell on, is market power.[165] 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, and easy access to credit that established corporations enjoy.[166]

Capital constraints are believed to be a particular problem for innovating entrepreneurs.[167] As Joseph Schumpeter emphasized, innovation can be a long and expensive process, both in terms of money and in terms of time and opportunity cost.[168] 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), 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.[169] During ESTD and pre-profit production and marketing, small businesses and entrepreneurs are likely to be vulnerable to funding gaps, *even in the presence of patents and other incentives to invent,* that do not trouble larger, better established firms.

How should U.S innovation policy respond to assist entrepreneurs stuck in the so-called stuck in the Valley of Death[170]? One option is to do nothing. Venture capital investors (VCs) have been a critical source of high-risk commercialization financing in the U.S.[171] But VC markets are cyclical and concentrated in certain regions.[172] Moreover, even high-risk investors may have a preference for innovations likely to turn quick profits and achieve exit in the near future.[173] Angel investors, which are present everywhere and more accessible to

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[165] Market power, the ability of a single actor or group of actors to have a substantial influence on market power, is considered a potential basis for government intervention in the market, for instance through antitrust law. Mankiw, supra, at 13. On possible forms of intervention such as antitrust or regulation, see id. at 219-23.

[166] See Graham et al, supra, 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 competitors.") *See also* Sichelman, supra, at 373 (noting the post-invention commercialization is especially acute for start-ups and independent inventors who lack the complimentary assets and market power of entrenched incumbents.) *See also* Hemel & Ouellette, supra, at 337 (noting that the structure of federal R&D tax incentives favors well-established corporations that can use credits and losses to offset current-year income, and it disadvantaged start-up companies that cannot [use them.]")

[167] See e, The Government as Venture Capitalist, supra, at 285-89 (reviewing "growing body of writing" suggesting new firms, especially technology-intensive ones, "may be receiving insufficient capital.")

[168] Indeed, as mentioned above, this led Schumpeter to reject small firms as a locus for true innovation. See Merges, supra, at 843 (discussing Schumpeterian perspective.)

[169] Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, supra, 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, Between Invention and Innovation, in TAKING TECHNOLOGICAL RISKS, supra, at 8-29 (same).

[170] See Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, supra, at 35-36 (noting that policymakers may dramatize the risk of under-capitalization 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.)

[171] See Gilson, supra, at 1068 (noting that venture capital markets in the U.S. have been "a major force in commercializing cutting-edge scienc[.])

[172] VC markets are cyclical and may be limited to certain geographic areas, such as Silicon Valley. Ibrahim, supra, at 746-47 (geographic limits of VCs); McGuire, supra, at 423-25 (contractions in VC markets).

[173] *See* Gilson, *supra*, at 1074-75.

entrepreneurs without connections, are therefore an important supplement to VCs.[174] But even assuming risk capital is available, various information asymmetries and trust problems can arise between technology entrepreneurs and putative financiers that restrict availability of capital.[175]

In two recent books, Robert Cooter argues that "innovation poses a problem of trust between innovators with ideas and financiers capital," which he calls the "double trust dilemma."[176] Cooter's double trust dilemma has two sides. The first side is seen from the perspective of inventors and entrepreneurs seeking funding: they worry their ideas will be copied without compensation in the absence of IP or other forms of protection, such as trade secret laws, contracts, and social norms that devalue copying.[177] 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."[178]

The second side of the double trust dilemma arises from the perspective investors, such as friends, family, angels, VCs – anyone that may be interested in funding a new technology. To varying degrees, investors may distrust both the ability and intentions of those seeking to spend their money while promising profits. They may see a risk of "shirking" – where an innovator who has received a grant to undertake a research project simply fails to do so with the money already in their pocket[179] – and the possibility that a newly funded company will stack the deck in management's favor, for instance by paying excessive salaries or spending too much on equipment (i.e. agency costs.[180])

As a result of this double-sided bind, 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. Private solutions, such as non-disclosure contracts and social norms that dissuade copying, along with contracts and corporate structures that mitigate agency costs, can go a long way towards mitigating these information

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174 See Ibrahim, supra, at 720-721 (highlighting the importance of angels and angel investor groups in financing innovation clusters like Silicon Valley.)

175 *See* Gilson, supra, at 1076-77 ("investing in early stage, high technology companies presents this problem [of uncertainty, information asymmetry and agency cost] in an extreme form.") *See also* Branscomb & Auerswald, *Between Invention and Innovation*, in TAKING TECHNOLOGICAL RISKS, supra, at 12 (describing the information and trust gap that exists between technologists on one side and investors/managers on the other.)

176 Robert Cooter & Hans Bernd Schafer, SOLOMON'S KNOT 6, 223 (2012). *See also* Cooter, THE FALCON'S GYRE 2 (2013) ("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.") *See also* Hemel & Ouellette, supra, 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*)*; Burstein, *supra*, at 242 (discussing Cooter's double trust dilemma and the disclosure paradox generally.)

177 On non-patent measures to protect information during transactions around information, see Burstein, supra, at 258-74.

178 Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention* (1962) (chapter in *The Rate and Direction of Inventive Activity: Economic and Social Factors*). The problem is similar to the appropriation risks associated with commercialization discussed above, except that it arises during attempts to raise capital through relatively personal relationships and can exist even in the presence of sufficient incentives to innovate. Hemel and Ouellette also note this distinction, considering "capital constraints" as a separate form of market failure from the need for financial incentives. See, e.g., Hemel & Ouellette, supra, at 336, 334-36.

179 *See* Kapczynski, supra, 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.")

180 On agency costs in venture capital investing, see Gilson, supra, at 1076-77.

and trust problems.[181] As discussed in Part I.B., invention patents are also said to play a key role in alleviating financing problems by protecting inventors from copying, clearly defining the technology at issue, and by creating additional rights of enforcement not entailed in contracts.[182] In addition, entrepreneurs' ownership (or license) of invention patents is thought to "signal" to investors the value of the technology and potentially of management.[183] Others have proposed "ex ante" government incentives to alleviate these problems, ranging from research procurement, to commercial financing, to R&D tax credits.[184]

III. COMMERCIALIZATION AWARDS

At this point I have shown that market failures may arise during commercialization of inventions that warrant government intervention, and that patent law scholars have recommended introducing new exclusive rights to confront them. However, in this part I show that, for better or worse, the United States already has a system of commercialization incentives to confront the market failures discussed above that do not require introducing unproven exclusive rights: direct financing for commercialization of science and technology-based research in the form of grants, loans, and equity (i.e. "commercialization awards.") 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,"[185] there is some evidence to suggest that they are reasonably effective commercialization incentives.

A. Commercialization Awards – A Descriptive Account

1. Federal Awards

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[181] *See* Burstein, supra, 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).

[182] See Merges, A Transactional View of Property Rights, supra, at 1519 (discussing the value of property rights in information as compared to contracts.) As Merges puts it, "[a] contract signifies a close, voluntary relationship between assenting parties, what one might call a legally 'intimate' relationship. … Property ownership gives a contracting party many small additional options that become collectively valuable only if the contract goes bad – if enforcement becomes necessary." Id. at 1519-20. In addition, property rights, mainly patents, facilitate disclosure of three types of information: information actually disclosed in patent applications, details not disclosed in the patent that inventors subsequently disclose, and valuable but unpatented information beyond the boundaries of the patent. Id. at 1500.

[183] See citation to scholarship on patent signal theory in Part I.B.2.

[184] See, e.g., Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, supra, at 41-55 (discussing various funding institutions for ESTD including corporations, venture capital firms, and angel investors, as well as universities, states and the federal government.) *See also* Branscomb, *Where Do High-Tech Commercial Innovations Come From?, Summary of Lecture at Duke Law School*, 0005 DUKE TECH. L. REV. (2004) (discussing debates over whether public financing such as ATP is needed to supplement private capital markets for high-tech start-ups.) *See also* Maryellen Kelley, *From Core Mission to Commercial Orientation: Perils and Possibilities for Federal Industrial Technology Policy*, 11 ECON. DEVEL. QUARTERLY, 313, 315-18 (1997) (discussing "dual-use" procurement programs like SBIR, and arguing for a more expansive definition of "dual use" to cover commercial innovations.) See also Hemel & Ouellette, supra, at 335-38 (arguing that capital market frictions may warrant ex ante incentives such as R&D tax credits and grants for early stage research.)

[185] See, e.g., Branscomb, *The National Technology Policy Debate*, in EMPOWERING TECHNOLOGY 26-27 (1993) (discussing lack of consensus on role of technology policy) (1993, ed. Branscomb.)

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 that are developing inventions with commercial potential that fall into the agencies' research areas,[186] and similar Small Technology Transfer Research (STTR) awards for small businesses that partner with research institutions.[187] Although each SBIR-granting agency controls its own solicitations, awards must be administered in three phases. Phase I awards, up to $150,000, are granted based on the "scientific and technical merit and feasibility of ideas that appear to have commercial promise."[188] Phase II awards, up to $1 million, are granted based on the small business' "record of commercializing SBIR or other research" and success in obtaining funding commitments from non-SBIR sources.[189] Phase III awards entail further interaction with the agency, but come with no further government funding.[190]

SBIR is an important exception to a general rule against direct federal financing for individual companies.[191] (Now we might call this the "Solyndra Rule.") As commentators like Fred Block and Marianna Mazzucato emphasize, while the U.S. private sector is a crucial driver of technological innovation, the federal government's investments in programs like SBIR, DARPA, In-Q-Tel, are hardly insignificant and cannot be ignored.[192] That said, since 2006 funding for SBIR has decreased by as much as $126 billion, suggesting that SBIR's role in helping small businesses commercialize may be declining.[193]

2. State Awards

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186 P.L. 97-219 (1982), codified in 15 U.S.C. § 638.

187 P.L. 102-564 (1992), codified in 15 U.S.C. § 638. Unless otherwise noted, when I discuss SBIR I am also discussing STTR.

188 15 U.S.C. § 638 (e)(4)(A) (SBIR), §638 (e)(6)(A) (STTR).

189 Id. at § 638 (e)(4)(B), §638 (e)(6)(B) (STTR).

190 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. § 638(e)(4)(C) (SBIR), § 638 (e)(6)(C) (STTR).

191 See Branscomb & Auerswald, Overcoming Barriers, in TAKING RISKS, supra, at 144 ("federal politics views with suspicion government programs to assist individual firms."); Berglund & Coburn, supra, at 483 (noting federal government's slow entry into cooperative technology development programs that directly engage industry for the express purpose of enhancing economic growth.)

192 See Mazzucato, *supra*, at 73-86 (discussing federal programs like SBIR and other funding for early-stage technology companies.); Block, *supra*, at 1-26 (suggesting that federally funded research conducted in federal labs and universities has supported commercial innovation.) *See also* Mazzucato, THE ENTREPRENEURIAL STATE 41 (Demos Pamphlet, 2011) (estimating that "programmes such as [SBIR] and the [now abolished] Advanced Technology Program (ATP) in the U.S. Dept of Commerce have provided 20–25 per cent of total funding for early stage technology firms.") *See also* William Galston, *Government Is a Good Venture Capitalist: Early-stage tech firms get more funding from Washington than from private VC investors*, THE WALL STREET JOURNAL, August 27, 2003 (summarizing Block's, Keller's, and Mazzucato's empirical contributions and economists' critiques that government is a bad VC and should not engage in picking winners and losers.)

193 See TESTIMONY OF ROBERT SCHMIDT, 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," May 21, 2014, at 5.

Along wit the federal government, U.S. states have long used public money to supply financing for entrepreneurs seeking to start new businesses.[194] In the past twenty years, states have increasingly begun to offer financing specifically for businesses attempting to commercialize technology and science-based ventures in their jurisdictions.[195] State commercialization awards tend to be more flexible than federal awards, ranging in size from around $30,000 to $2 million in the form of cash, loans, or equity. Many are derivatives of federal awards, available only for selected winners of SBIR awards.[196] 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 locate in Kentucky.[197]

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, helping companies reach a stage where they can obtain private investment. [198] To be eligible for state commercialization awards requires undertaking

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[194] See Peter K. Eisenger, The Rise of the Entrepreneurial State: State and Local Economic Development Policy in the United States 241-265 (1988).

[195] 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 1, NATIONAL BUREAU OF ECONOMIC RESEARCH (A. Jaffe and B. Jones, eds. 2014) (noting 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 SCIENCE & TECHNOLOGY INSTITUTE REPORT, TRENDS IN TECHNOLOGY-BASED ECONOMIC DEVELOPMENT: LOCAL, STATE AND FEDERAL ACTION IN 2012 7-9 (2012) [hereafter SSTI] (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 (1995) (containing a comprehensive survey of state technology programs circa 1995). For helpful law review articles reviewing state financing for high technology, see Terrance McGuire, *A Blueprint for Disaster? State Sponsored Venture Capital Funds for High Technology Ventures*, Note, 7 HARV. J. LAW & TECH. 419 (1994) (overview and detailed analysis of programs in Massachusetts Michigan); David Ibrahim, *Financing the Next Silicon Valley*, 87 WASH. U. L. REV. 717, 736-39 (2010) (discussing state sponsored VC as potential source of funding for early-stage start-ups.) *See also* Cable, *supra*, at 202-204 (discussing city venture development funds.)

[196] See survey of state derivatives in David 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, 11 Tul. J. Tech. & Intell. Prop. 115 (2008).

[197] See Kentucky Cabinet for Economic Development, "Kentucky first state to match federal SBIR-STTR Phase 1 and Phase 2 grants," 16-Nov-2006 ("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."), http://www.eurekalert.org/pub_releases/2006-11/kcfe-kfs111606.php More information available at http://ksef.kstc.com/index.php/funding-programs/ky-sbirsttr-matching

[198] 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." Indiana Code § 5-28-16-2(a); EIGHTH REPORT TO THE INDIANA GENERAL ASSEMBLY: 21ST CENTURY RESEARCH AND TECHNOLOGY FUND, Indiana Economic Development Corporation, at 4. Another example is Iowa's "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 private funding*." See Iowa Admin. Code § 261-105.2 (15) (purpose), 261-105.4(15) (project based). *See also* Iowa Code § 15.411.3. "Innovative business" is defined in Iowa Code 15E.52(1)(c) as "a business applying novel or original methods to the manufacture of a product or the delivery of a service." See also http://www.iowaeconomicdevelopment.com/Entrepreneurial/DemoFund

a commitment to commercialize within a "reasonable period of time" and frequently requires locating all or some commercialization activities in the state.[199]

For example, in Oklahoma, where I conducted interviews, the legislature finances a complete Technology Commercialization Center (TCC.)[200] 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 and processes or services within a reasonable period of time and a significant potential for stimulating economic growth within the State of Oklahoma[.]"[201] 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.[202]

When granting such awards, states seek to spur long-term innovation and also seek near-term economic benefits from companies locating, paying taxes, and hiring workers in the state and at higher wages than in non-innovating sectors.[203] States and cities also seek efficiency grains from so-called "agglomeration advantages," including lower transportation costs, larger market sizes, and localized knowledge spillovers, all of which are believed to

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Iowa's "Acceleration Fund" provides additional financing for innovative businesses in the later stages or businesses that partner with state universities for "the development of innovative ideas and businesses[.]" See Iowa Admin. Code § 261 –108.2(15), 105.6(15) (location in Iowa required).

[199] Texas' 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. Code 490.001(4) (equity awards); 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." Tex. Gov. Code 490.151 (eligibility limited to collaborations); 490.155 (contractual guarantee of operation in Texas). See also description of Commercialization Awards on the Governor's website, http://governor.state.tx.us/ecodev/etf/etf_commercilization_awards

[200] 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, 201,.I spent several hours interviewing Casey Harness, External Relations Coordinator, Director of the i2E Fellows Program, and Oklahoma Bioscience Association Liaison, in Oklahoma City, Okla.

[201] Emphases all added. Okla. Admin. Code 650:10-1-1 (purpose); Okla. Admin. Code 650:10-1-7 (eligibility); Okla. Stat. 74-5060.4.8 (definition of "enterprise"). "Applied research" means research activities having "potential commercial application." Okla. Stat. 74.5060.4.3. See also OARS website: http://www.ok.gov/ocast/Programs/Oklahoma_Applied_Research_Support_(OARS)/

[202] See Okla. Stat. § 74.5060.21 (authorizing 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 www.i2E.org

[203] McGuire, supra, at 419, 420-22. On higher wages and expected benefits from hiring in high innovation sectors, see also Enrico Moretti, THE NEW GEOGRAPHY OF JOBS (2013).

result when businesses locate close to other businesses in related industries.[204] This goal is closely associated with growing "clusters," a policy popularized by Michael Porter.[205]

B. Commercialization Award Features

Based on analysis of SBIR and state awards, I identify several key features of commercialization awards. They are as follows.

1. Regulatory Objective

The general regulatory objective of a commercialization award is to assist entrepreneurs, including individual inventors, start-ups, and small businesses, that are seeking to commercialize inventions but experiencing difficulties raising money to reach a stage at which private financing becomes feasible.[206] I call this the "marginal commercalizer." To be eligible for an award, applicants must show government's participation is "instrumental" to the success of the enterprise[207] and undertake a commitment to commercialize within a "reasonable period of time."[208]

2. Relatively Small Awards Calibrated to Need

Commercialization awards can range in size from around $10,000 to $2 million in the form of cash, loans, or equity. They are usually calibrated to the specific commercialization needs of the applicant, as detailed in an application or fundraising pitch.[209]

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[204] Expected agglomeration benefits include lower transportation costs, larger markets from which to obtain labor and other necessary inputs, and knowledge and expertise that is shared among talented individuals in similar fields located nearby to one another. *See* Daniel Rodriguez & David Schleicher, *The Location Market*, 19 GEO. MASON L. REV. 637, 641-45 (2012) (applying agglomeration theory to city location markets.) *See also* Cable, supra, at 199-200, 212-225 (discussing agglomeration economies in the context of city venture development funds, noting that benefits include, e.g., "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.")

[205] Michael Porter, *Clusters and the New Economics of Competition, Harvard Business Review* (November-December 1998), On cluster theory as applied to technology development specifically, see, e.g., Thomas Lyon & Russell Baruffi, *Creating a Plug-In Electric Vehicle Industry Cluster in Michigan: Prospects and Policy Options*, 18 MICH. TELECOMM. & TECH. L. REV. 303, 305-309 (2011). On the organic evolution of Silicon Valley, see Analee Saxenian, REGIONAL ADVANTAGE: CULTURE AND COMPETITION IN SILICON VALLEY AND ROUTE 128 4, 9, 34 (2d Ed. 2006).

[206] See Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, supra, at 1. On "dual use" objective of SBIR awards see Kelley, *From Core Mission to Commercial Orientation*, supra, at 315-18.

[207] This language comes from the Oklahoma program; but I do not include the location requirement. *See* Okla. Stat. § 74.5060.21.F2.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[.]")

[208] This language comes from various statutes and administrative codes. See, e.g., Iowa Admin. Code § 261-105.2 (15).

[209] See, for instance, the NIH's 2013 omnibus SBIR solicitation notice. Reissue PHS 2013-02 Omnibus Solicitation of the NIH for Small Business Technology Transfer Grant Applications (Parent STTR [R41/R42), http://grants.nih.gov/grants/guide/pa-files/PA-13-235.html See also the Texas' Emerging Technology Fund (ETF) application, which requires itemizing all funding sought from the state, along with a "breakdown of

3. 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.[210] Sometimes called "staged" or "tiered" financing, this allows government to mitigate risk by limiting the amount of public money spent until further success is apparent. It also creates an additional performance incentive for the company.[211]

4. Professional Management

Awards are either managed within government agencies, as with SBIR and some state programs, or are contracted out to private investment firms.[212] Either way, neutral, professional managers are (or in certain cases should be) the norm.

5. Invention Patent Ownership

An important feature of commercialization awards from the perspective of commercialization theory is that they encourage patent ownership by award recipients. Award administrators typically require itemizing all patents and IP that the company has obtained or plans to obtain.[213] Administrators may give extra weight to ownership of patents

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other funding [the applicant is] seeking in parallel with the TETF award." Texas ETF Commercialization Award Application, at 6, available here: http://governor.state.tx.us/ecodev/etf/apply_commercialization

[210] SBIR awards come in three phases, the first two of which involve funding. See discussion *supra*. 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; seed stage (up to $2,000,000 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 $2 million. See Iowa Admin. Code § 261 –108. For more details see Iowa Economic Development Authority website: http://www.iowaeconomicdevelopment.com/Entrepreneurial/SSBCIInnovation

[211] On VC's use of staged financing as a performance incentive, see Gilson, supra, at 1079. See also Abramowicz, Perfecting Patent Prizes, supra, at 175 (noting that "it may be appropriate for rewards to be deferred until after there has been some time for commercialization.")

[212] For instance, since April, 2011, Indiana's 21st Century Fund, descried above, has been managed by Elevate Ventures, a nonprofit under contract with the Indiana Economic Development Corporation and the State of Indiana. See 21st Century fund website: http://www.21fund.org/ *See also* Indiana Code § 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. Okla. Stat. § 74-5060.2.B.

[213] Federal agencies participating in SBIR also require identification of relevant IP in proposals. For instance, NIST and NIH's SBIR solicitations require that all IP be noted on a single page in the proposal and labeled as confidential and proprietary. *See* Reissue PHS 2013-02 Omnibus Solicitation of the NIH for Small Business Technology Transfer Grant Applications (Parent STTR [R41/R42), http://grants.nih.gov/grants/guide/pa-files/PA-13-235.html. See also SBIR/STTR Manual for Faculty, Staff, and Students, University of South Carolina Research Foundation, March 2007, at 18-19 (identifying variety of ways in which different agencies require identification of IP in SBIR proposals), available at: http://ip.research.sc.edu/PDF/SBIR-STTRmanual.pdf See also, e.g., Iowa Demonstration Fund Application, at 8-9, available at http://www.iowaeconomicdevelopment.com/Entrepreneurial/DemoFund (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.) See also, e.g., Texas ETF Commercialization Award Application, at 7 ("List any issued or pending IP including dates, numbers and descriptions, including patents, trademarks, copyrights and

and other IP in making awards.[214] In theory, this strategy increases the incentive to commercialize rapidly and also permits patent ownership to serve as a signal of commercial potential.[215]

6. Matching Requirements

Lastly – and most significantly from the perspective of the patents-prizes debate[216] – commercialization awards increasingly require securing simultaneous financing from private sources.[217] This strategy is called "matching" or sometimes "leveraging," to indicate that public money is being "combined with private funds to leverage the impact of the state's resources."[218] With strict matching requirements, government may still do the first significant due diligence on an applicant to determine technical and commercial potential, but then will require equal co-investment from private sources *before* closing a financing contract.[219]

C. Measuring Commercialization Awards' Efficacy

Do commercialization awards actually increase or accelerate commercialization of new technologies? There are some eye-popping numbers. For example, in his recent testimony before the House of Representatives speaking in support for more funding for the SBIR program, 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 produced 25% of America's "R&D 100 Awards."[220] Moreover, Schmidt states, SBIR companies have "been involved in 1,710 M%A transactions" (this is 7.8% of all awardees) and "play an outsize role in net job creation in the United States."[221]

Similarly enthusiastic data has been released by the states. For instance, the Texas Emerging Technology Fund (ETF) reports that between 2005 and 2012 Texas gave $195

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trade secrets"), available at: http://governor.state.tx.us/ecodev/etf/apply_commercialization

[214] 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, December 20, 2013.

[215] See, e.g., Eisenberg, *Public Research*, supra, at 1663-65 (discussing policy behind Bayh Dole Act and SBIR to use patents to push market transfer.) On signal theory and debates, see Part II.C.3.

[216] See, e.g., Hemel & Ouellette, supra, at 303 (noting the key distinction between patents and prizes is whether they are market or government set.)

[217] For state examples, see, e.g., Iowa Admin. Code § 261 –105.5(15) ("In order to receive financial assistance, an applicant must demonstrate the ability to secure one dollar of nonstate moneys for every two dollars received from the authority); Okla. Admin. Code 650:10-1-11 (requiring at least 50% 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 comes with no government financing, instead requiring companies to obtain private investment to continue participating in the program. 15 § 638(e)(4)(C) (SBIR), § 638 (e)(6)(C) (STTR).

[218] McGuire, supra, at 429 (discussing leveraging); Ibrahim, supra, at 737 (discussing matching.)

[219] 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. 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.

[220] See Schmidt Testimony, supra, at 9.

[221] Id.

million in commercialization awards to 137 companies, which then went on to raise over $750 million from non-state sources.[222]

But of course what really concerns us is not just whether commercialization awards are correlated with commercialization of inventions; 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.[223]

1. Empirical Studies

The first form of evidence is empirical studies that compare award winners to similarly situated companies that did not receive awards. 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.[224] Josh Lerner's study of SBIR awards suggests they have had a positive impact on awardees' ability to grow as compared to similarly situated companies, especially when awardees were located in regions where they had access to private sources of capital. 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.[225]

In 2012, Bo Zhao and Rosemarie Zeidonis contributed to this line of research at the state level. Building on Lerner's study of SBIR awards, they performed a similarly designed empirical study of a Michigan commercialization awards program and found a similar effect as Lerner: not only did awards enhance company survival as compared to similar prospects, but they apparently produced a certification effect that helped award recipients obtain additional financing from private investors with bigger pockets.[226]

In 2002, Maryann Feldman and Maryellen Kelley used case studies to evaluate state programs designed to support technology-pioneering start-ups. Specifically, they tracked the progress of four winners of federal Advanced Technology Program (ATP)[227] awards who also received state funding (e.g. public venture funds or matching funds) and other support,

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[222] See ANNUAL REPORT TO THE TEXAS STATE LEGISLATURE ON THE TEXAS EMERGING TECHNOLOGY FUND (2012), available at: http://governor.state.tx.us/ecodev/etf/ As discussed below, there are plenty of reasons to doubt these numbers, including accusations of corruption. See news reporting by Litman in note *supra*.

[223] Importantly, this does not address the extent to which governments' 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.

[224] *See, e.g.,* Josh Lerner, BOULEVARD OF BROKEN DREAMS: WHY PUBLIC EFFORTS TO BOOST ENTREPRENEURSHIP AND VENTURE CAPITAL HAVE FAILED – AND WHAT TO DO ABOUT IT 181-90 (2009); Lerner, *Boulevard of Broken Dreams: Innovation Policy and Entrepreneurship*, in INNOVATION POLICY AND THE ECONOMY 61-81 (Josh Lerner and Scott Stern, eds. 2013).

[225] Josh Lerner, *The Government as Venture Capitalist: The Long-Run Effects of the SBIR Program*, 72 U. CHICAGO JOURNAL OF BUSINESS 285-318 (1999) (assessing impact of SBIR awards between 1983 and 1995, finding that over a ten 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.)

[226] See Bo Zhao & Rosemarie Ziedonis, State Governments as Financiers of Technology Startups: Implications for Firm Performance, at 2-3 (July 2012) (unpublished manuscript), available at http://ssrn.com/abstract=2060739 (analyzing economic effects of Michigan Life Sciences Corridor (MLSC) program launched in 1999).

[227] ATP has since been abolished, on which see Schacht, supra, at 1-2, 5.

such as help from university-based technology transfer programs or access to university facilities, from states to facilitate commercialization.[228] They concluded based on these cases that state venture capital programs, though small compared to federal R&D grants or venture capital, "appear[ed] to nurture [the] firms development."[229]

2. Case Study

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."[230] Although I do not argue that this case study represents a statistically significant average, like Feldman and Lanahan's case studies, 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 otherwise have.[231]

Bruce is a research scientist in psychiatry at Yale. Around ten years ago, he developed a computer-based brain-training program for harnessing neuroplasticity and improving cognitive function, with 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. But their employer would not license them the IP, even though it was not planning to develop their model. The company did, however, give him rights to do non-commercial research.

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.[232]

With Yale's help, Bruce and his partner began to raise money from angel investors including friends, family and neighbors. Angels invested around $600,000 in exchange for equity. Yale 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

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[228] Maryann Feldman & Maryellen Kelley, How States Augment the Capabilities of Technology-Pioneering Start-Ups, 33 Growth & Change, 173, 175-78 (2002).

[229] Id. at 173. See also Maryann Feldman & Lauren Lanahan, *Silos of Small Beer – a case study of the efficacy of federal innovation programs in a key Midwest regional economy*, Center for American Progress, at 3-4 (2010) (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.)

[230] Interview with Research Scientist at the Yale School of Medicine, in New Haven, Conn. (October 26, 2013). I had a follow-up interview with Bruce on July 14, 2014 in New Haven, Connecticut.

[231] On the utility of case studies for discussing the efficacy of innovation incentives such as patents, see Kristen Osenga, *Formerly Manufacturing Entities* (working paper 2014).

[232] 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. They will also receive a percentage of sales royalties, to diminish over the lifetime of the patents.

entrepreneurs.[233] 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.[234] CI agreed to give them a $350,000 loan. "*This was critical*," Bruce says. "*It was the biggest single investment we got up to that point*."

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% of applicants.[235] Their anonymous expert reviewer determined that theirs was the "most sophisticated brain training program ever conceived." However, unlike the CI award, Bruce's company cannot use the NIH award for commercialization needs. They get around $40,000-$50,000 a year to support clinical trials at Yale, and the rest goes to the university and overhead expenses. Thus, they still need to raise significant amounts of capital to fund operations and begin product sales. They continued to rely on angels and on CI, which chose to convert its loan into equity and gave around $150,000 more in operating capital. They are currently seeking a third round of financing from CI, hoping to get $2 million plus.

Bruce's company has now started selling a version of the product to children in various states, including Virginia, Alaska and California. Over 3000 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 recently contracted with a small company to do their marketing. The company is not profitable but hopes to be in a few years.

Ongoing concerns include the expense of product tweaking, marketing, and production, and the entry of competitors that have also 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.[236] For purposes of evaluating their efficacy as a commercialization incentive, the most significant critique stems from the fact that commercialization awards require

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[233] Con. Gen. Stat. Chapter 581, § 32-32 through 32-47a. The legislature created a variety of investing programs to be run by CI including a Critical Technologies Grant Program, Conn. Gen. Stat. § 32-41n, an Early-Stage Venture Capital Program, Conn. Gen. Stat. § 32-41w, and a Pre-seed Financing Account and Program, Conn. Gen. Stat. § 32-41x.

[234] Patents were less important to CI than other signs of technical and commercial merit.

[235] Bruce considered applying for an SBIR grant to get the commercialization funding they needed. But he rejected this option – even though NIH had an SBIR solicitation that was specifically related to brain training for children via video games. His main reasons for rejecting the SBIR route were that he didn't like the idea of directing his research towards child video games and "the SBIR grant was small, and it would take too long to get the money."

[236] 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* (NBER, working paper August 2013) (examining 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 shifting of activity from state to state rather than real gains.) See also Hrdy, *Do State Incentives for Innovation Work?,* WRITTEN DESCRIPTION, August 23, 2013 (discussing this study and its limits.)

government to identify and value new technologies with unproven technical and commercial merit before they have been proven in the marketplace. I unpack and respond to this critique below.

1. The "Government Set" Critique, Generally

Commercialization awards are what Daniel Hemel and Lisa Larrimore Ouellette call "government-set" incentives. They are awarded by the government for a project and a company selected by government officials, employees, or contractors. Government-set incentives are widely thought to be "inefficient when the government cannot foresee a potential invention or evaluate its costs and benefits," leading to under-valuation – where innovators chose not pursue the project despite its social value – or over-valuation – which "[diverts] innovators' attention from more useful endeavors[.]"[237] Besides potentially distorting investment in innovation, grants are a risky way to use public money. As Brett Frischmann puts it, "when utilizing grants, the government as investor principle often bears the entire downside risk of an unsuccessful project."[238]

In deciding whether a government-set incentive is appropriate, the main questions to ask are whether this is an area where government can do a good job at evaluating costs and benefits as compared to private markets,[239] and, relatedly, whether it is appropriate to spend taxpayer money on the objective.[240] Valuing the market demand for an invention would indeed seem to be an area where the government is not well-suited as compared to private investors. Due to what F.M. Scherer and Dietmar Harhoff call the "high skew" nature of innovation, investing in high technology ventures is a high risk, high return prospect. The expectation of any investor should be that most will fail, even if some win very big.[241]

Although there is no inherent reason government could not be a successful investor in individual inventions and technology start-ups, this seems to require two major assumptions: first, that government adopts appropriate investment strategies (including, at minimum, a "portfolio" strategy that spreads risk among many prospects[242]), and, second,

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[237] Hemel & Ouellette, supra, at 327. *See also* Frischmann, *Innovation and Institutions*, *supra*, at 387 (explaining that grants do "not rely on the market to signal public demand for innovation-dependent goods 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.")

[238] Frischmann, *Innovation and Institutions*, *supra*, at 387.

[239] Hemel & Ouellette, supra, at 327; Frischmann, *Innovation and Institutions*, *supra*, at 387.

[240] As Hemel and Ouellette explain, an oft-stated benefit of patents as opposed to grants or prizes is that patents avoid taxing the general populace to produce innovations that only a selection of the populace actually end up using them. Hemel & Ouellette, supra, at 346 ("Of the principle policy mechanisms discussed above, the patent system is unique in that the payers are purchasers of the patented products, such that the patent system limits the extent to which non-users subsidize users.") (discussing Gallini & Schotchmer's work).

[241] *See* F.M. Scherer & Dietmar Harhoff, *Technology Policy for a World of Skew-Distribution Outcomes*, in TAKING RISKS, supra, at 125.*See also* Scherer & Harhoff, *Technology Policy for a World of Skew-Distribution Outcomes*, 29 RESEARCH POLICY 559-66 (2000). Following Mansfield's 1977 study estimating the social returns from academic research at 20%, 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 561-62.

[242] Advocating a portfolio strategy for technology policy is the natural outcome of the observation that investing in technology is a "high skew" endeavor, with only a few companies winning big. See, e.g., Scherer & Harhoff, supra, at 562 ("Our results also suggest the wisdom for technology policy in Mao Tse-Tung's aphorism, "Let one hundred flowers bloom'…")

that government is willing to take the same kinds of risks as private investors.[243] Both assumptions are significant.

1. Government as "Venture Capitalist"?

There are undeniably practical problems that hinder government's performance at evaluating inventions' commercial potential *when compared to private investors* (e.g. VCs). In his recent article on high-risk financing in Silicon Valley, David Ibrahim concluded that U.S. state venture capital programs are doomed to fail because government officials are poor venture capitalists when compared to private VCs and angel investors.[244] He gives two reasons. First, public fund managers will be under-compensated and under-skilled compared to private fund managers.[245] Second, government officials are likely to interfere with investment decisions and "may have more incentive to select start-ups for political reasons, including immediate if unsustainable job creation."[246]

I agree that a risk of commercialization awards, especially at the local level, is that politicians will pressure award administrators to select companies for political economic reasons.[247] Not surprisingly, at least two 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.[248] Texas' Emerging Technology Fund has also had problems, with Governor Perry being accused of funneling Commercialization Awards to friends and campaign donors.[249] Inter-jurisdictional competition is a particularly compelling explanation for the latter, given Governor Perry's known campaign to attract business to his state.[250] As Brian Galle observes, local incentives in the form of *subsidies* (e.g. tax credits, commercialization awards) are especially vulnerable to unproductive rent-seeking by mobile firms that threaten to locate in other states if not rewarded.[251]

However, despite these risks, I disagree with Ibrahim that better design, including, more public monitoring and more use of independent committees, cannot alleviate if not eliminate these risks.[252] In particular, Ibrahim is too quick to dismiss standardized, strictly

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[243] On government's lower risk threshold than private investors, see Scherer and Harhoff, supra, at 561-62.
[244] Ibrahim, supra, at 736-39 (drawing on Ronald Gilson's notion of the proper financial intermediary.)
[245] Id. at 736-37.
[246] Id. at 737. *See also* Benjamin & Rai, supra, at 13 (arguing that another reason innovation policy may suffer when directed by government actors is that they "have very little incentive to force themselves to think about long-term outcomes, as they are unlikely to be around to reap credit (or blame).")
[247] 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.)
[248] Bates allegedly received $500,000 in taxpayer money from an Elevate-run fund. A company run by Bates' son allegedly received $300,000 from Elevate. For a recent report on these allegations, see Alex Campbell, INDYSTAR, June 19, 2014, 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/
[249] See Malia Litman, *The Fire of Corruption Rages in Rick Perry's Texas*, October 20, 2011, http://malialitman.wordpress.com/2011/10/10/the-fire-of-corruption-rages-in-rick-perrys-texas/
[250] *See* Editorial, "Farewell, Ambassador Perry: Texas' departing governor loves to nab other states' companies," BUSINESS WEEK, July 15-July 21, 2013.
[251] Galle, supra, at 841-43.
[252] For instance, in response to the allegations 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

enforced *matching requirements* as a solution to both the problem of valuation and the problem of political influence.[253] Policy analysts including Lerner and others have looked 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."[254]

More importantly, I disagree at a fundamental level regarding the ultimate purpose of commercialization awards. The goal is not to award the *best companies* and match the returns of private VCs, as Ibrahim's analysis implies.[255] The best companies get funding from private investors anyway; they are not the target. Rather, like commercialization patents and other innovation incentives, commercialization awards seek to resolve the market failures described in Part II and increase investment in commercializing externality-generating inventions, especially by entrepreneurs struggling with funding gaps and transaction costs on the road to commercialization.[256] Accordingly, award recipients should not be those companies that private investors would have supported without government help. Rather, as explained in Part III.B.1., the ideal award recipient is the "marginal commercializer" that cannot obtain sufficient financing without government support. True, government may miscalculate, giving money to horrible companies or companies that would have received private investment anyway. Like any government tax or subsidy that distorts the market, this generates deadweight loss.[257] But the deadweight loss produced by governments' misallocations may be worth the benefits, just as with other innovation incentives, including IP.[258] Whether commercialization awards are more or less effective than commercialization patents is the subject of Part IV.

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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. On the ETF advisory committee, see http://governor.state.tx.us/ecodev/etf/etf_advisory_committee *See also* ANNUAL REPORT TO THE TEXAS STATE LEGISLATURE ON THE TEXAS EMERGING TECHNOLOGY FUND (2012), available at: http://governor.state.tx.us/ecodev/etf/

[253]Ibrahim recognizes the promise of government providing only matching funds.[253] But he concludes this will not significantly improve government's performance, suggesting that VC's may not be entirely free from state influence, Ibrhim, supra, at 737, and that, since state-funded investing may involve more "red tape" and public disclosures than other investments, this will make them unattractive to VCs and lead to an adverse selection problem. Id. at 738 (stating that because "it is unlikely that the best private VCs will avail themselves of state funds," this will leave "a market for lemons among the private VCs who will accept state funds.") As just mentioned, the political pressure issue could be alleviated by better monitoring and required disclosures; and I do not see any evidence of an adverse selection problem. To the contrary, Lerner's and Ziedonis' studies suggest the opposite: that awards produced "certification effects," enhancing the likelihood of obtaining private investment.

[254] Martin & Scott, supra, at n. 12 (discussing proposed matching mechanism.) See also, e.g., Lerner, BOULEVARD OF BROKEN DREAMS, supra, at 181-90 (discussing ways to improve national programs);

[255] To be fair, Ibrahim was not analyzing public venture capital *as an innovation policy* to correct market failure. He was simply comparing their performance to private investors.

[256] See Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, *supra*, at 1; Zhao & Ziedonis, supra, at 4 (describing goals of state technology financing); Graetz & Doud, supra, at 348-50 (describing justification for government innovation incentive, generally.)

[257] See Mankiw, supra, at 159.

[258] See Kapczynski, supra, at 979-80 (on deadweight loss of patents.) See also Mankiw, supra, at 220-21 (discussing the need for public subsidies for education and basic research despite the chance for deadweight loss.)

2. Is the Opportunity Cost Too High?

Even if government can do a reasonably good job at awarding marginal commercializers to spur innovation and economic activity, unlike private investors, government is charged with spending public money. As such, government's risk threshold may be far lower than private investors'. The prospect of a 1/10 success rate may be unappealing.[259] Along with the political risk associated with losing taxpayer money, government's opportunity cost is extremely high. Maybe government could use taxpayer funds more productively. The most obvious option is to provide subsidies for education.[260] Another is to improve workforce education and training and increase the capacity of local populations to work at innovative firms.[261]

A cheaper option for helping technology entrepreneurs is to provide know-how rather than money.[262] States already offer a variety of guidance and networking programs to help small businesses get information and access private capital.[263] For instance, Oklahoma's TCC provides assistance for Oklahoma companies, including technology assessment, business model evaluation, and help locating private investors, as well as an "Inventor's Assistance program," which provides patent searches, business counseling, and "any other assistance necessary to develop the product to the commercial stage."[264] 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.[265]

This approach benefits start-ups in spaces like IT, where costs are lower. But it may be of limited help to companies developing science-based research with long testing time, his costs, and lab space requirements. If government chooses to offer financial incentives for types of entities (marginal commercializers), the question is how to do it: commercialization

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[259] As Scherer and Harhoff put it, "[l]egislators 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, at 561-62.

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

[261] *See, e.g.*, Peter Downs, *Can't Find Skilled Workers? Start an Apprentice Program,* THE WALL STREET JOURNAL, JAN 16, 2014 (discussing apprentice programs in other counties and St. Louis.) *See also* Susana Borrás & Charles Edquist, *Education, training and skills in innovation policy,* SCIENCE AND PUBLIC POLICY, published online July 15, 2014. See also Lobel, supra, at 9 (stressing import of trained, talented individuals.)

[262] Abe Cable has made a similar suggestion to focus on cheaper policies based on his analysis of city venture development funds (VDFs), asserting that public policy efforts should focus instead on supporting "nimble and innovative start-up companies" and promote "new financing technology that takes advantages of entrepreneurs' ability to do more with less." Cable, supra, at 249.

[263] Berglund & Coburn, supra, at 27-9 (discussing start-up assistance and incubators), 29-31 (discussing state networking programs). On state programs to improve companies' access to venture capital, see also Brian Krumm, *State Legislative Efforts to Improve Access to Venture Capital*, in ENTREPRENEURSHIP AND INNOVATION IN EVOLVING ECONOMIES: THE ROLE OF LAW (Megan Carpenter, ed. 2012).

[264] Okla. Stat. § 74-5064.4(B)(2). See also https://www.ok.gov/ocast/Programs/Oklahoma_Technology_Commercialization_Center_%28OTCC%29/

[265] See http://www.vtsbdc.org/ See also http://www.vtsbdc.org/programs/small-business-technology-commercialization

awards or some other incentive like commercialization patents? This is the final question addressed in Part IV.

IV. COMPARING SOLUTIONS TO COMMERCIALIZATION MARKET FAILURE

Having established that market failures exist in commercializing inventions and that government already employs commercialization 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 and spur entrepreneurial activity.[266] In this part, I analyze how such commercialization patents compare to commercialization awards as responses to the commercialization market failures identified in Part II. The table in the Appendix summarizes the two distinct responses.

Can we conclude one mechanism for responding to market failure is better than the other? To do this requires paying attention to *both* the expected private benefits for award recipients and the expected social benefits of offering incentives. Moreover, it requires making decisions about which market failure is more significant. As I show below, there is potentially a conflict between the goal of internalizing spillovers and the goal of supporting entrepreneurs.

A. Commercialization Patents

1. Effectively Internalizing Spillovers

As explained, one of the most important features of commercialization theory since Kitch is its emphasis on the risk of "free-riding" on information produced during commercialization. Commercialization patents would significantly reduce investment risk associated with generation of new information. With the important exception of business method patents,[267] patents for inventions are limited to the "novel" and "nonobvious" aspects of a technological innovation.[268] Commercialization patents cover far more information, including information that is *only* produced once an innovation is commercialized, such as predictions of market demand.[269] This significantly increases the chance for real economic market power (the ability to charge prices above marginal cost), as well as the possibility of future licensing royalties to competitors and returns from enforcement against infringers.[270] By reducing the risks and increasing the expected rewards,

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[266] To review, these include traditional patents that cover "commercially nonobvious" information, see Duffy & Abramowicz, supra, at 405, and separate commercialization patents that provide a short term of exclusivity for "substantially novel" products whose underlying inventions are potentially patentable (or already patented) but have not yet been commercialized. Sichelman, supra, at 346. Unless otherwise noted, in this part I refer to both forms of incentives as "commercialization patents."

[267] Abramowicz & Duffy, supra, at 400-407 (discussing ways that patents already reward "commercially nonobvious" innovations like business methods.) See also d. at 339, n. 4 (defining market experimentation.)

[268] See 35 U.S.C. 101, 102, 103.

[269] Abramowicz & Duffy, supra, at 400-407 (emphasizing need for patents to protect investments in market experimentation.) On the information produced only through working patents, see also Duffy, Reviving the Paper Patent Doctrine, supra, at 1359.

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

this incentive should increase the chances that inventors and firms will invest in further developing and marketing innovations that might benefit second movers if commercialization is successful. [271]At the least, the availability of commercialization patents should accelerate the pace at which this process occurs.[272]

Along with increasing and accelerating the pace of commercialization, commercialization patents might result in more efficient allocation of investment resources by creating fully alienable property rights in new information produced during commercialization.[273] Commercialization patent owners that are not well suited to commercialize themselves could transfer or license their rights to those who can do so more efficiently.[274] Additionally, commercialization patents should reduce transaction costs for commercializers attempting to license pre-existing invention patents. Abramowicz & Duffy's proposal uses doctrinal rules governed by courts.[275] Sichelman's proposal endows successful commercializers with immunity from injunctions based on underlying invention patents, requiring only payment of a reasonable royalty. [276]

2. But Would Commercialization Patents Help Entrepreneurs?

On the other hand, commercialization patents have significant downsides – especially with respect to the challenges faced by entrepreneurs in commercializing inventions during the Valley of Death.

First, as an initial matter, although commercialization patents prevent more commercialization spillovers than invention patents, they 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 (e.g. medical checklists.)[277]

Second, commercialization patents are not limited to marginal commercializers: inventors and start-ups who would not be able to commercialize their invention *in the absence of a government incentive*.[278] 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 significantly reduce the risk of outside investors agreeing to fund the project because, as Smith might put it, "if the invention be good and such as is profitable to

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[271] For an analysis of how patents alter the risk-assessment calculus for the marginal inventor, see Merges, *Uncertainty and the Standard of Patentability*, *supra*, at 1-5. *See also* Chiang, supra, at 72-5 (discussing the effect of patents on incentives to undertake research in the presence of uncertainty.)

[272] On the role of patents as being to accelerate innovation, see Abramowicz & Duffy, *Inducement Standard of Patentability*, *supra*, at 1599; Chiang, *supra,* at 57-58 (observing that the "patent system creates no inventions, it *accelerates* them.")

[273] Merges, A Transactional View of Property Rights, supra, at 1481. See also Kitch, supra, at 277; Kieff, supra, at 703.

[274] See, e.g., Risch, *Licensing Acquired Patents*, GEO. MASON L. REV. (forthcoming 2014) (discussing various theories about the commercialization benefits of patent licensing by entities that acquire patents in different contexts, incldluing for commercialization purposes.)

[275] *See* Abramowicz & Duffy, supra, at 403-404.

[276] Sichelman, supra, at 346.

[277] On unpatentable innovations left out by the patent system, see, e.g., Douglas G. 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.) See also Kapcynski & Syed, supra, at 1901 (on medical innovations and other socially valuable subject matter for which exclusivity is not a useful incentive).

[278] For patentability standards focused on the marginal innovator, see Abramowicz & Duffy, Inducement Standard of Patentability, supra, at 1599; Merges, Uncertainty Standard of Patentability, supra, at 1-5.

mankind, [they will] probably make a fortune by it."[279] But awards might go to large corporations that already have the resources to invest in commercialization.[280] This could lead to more market consolidation rather than a market structure amenable to open competition among small firms. As explained in PartII.C.3., the latter are thought to be more innovative; and the government has indicated a desire to help entrepreneurs.[281]

Third, to the extent commercialization patents go to those who need them, 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.[282] This could be a serious problem for new or small companies experiencing funding gaps during early-stage technology development and commercialization.[283]

As explained in Part I, patent commercialization theories suggest commercialization patents could nonetheless help entrepreneurs raise financing ex ante to commercialization. For instance, they might permit entrepreneurs to more freely disclose to investors "substantially new" technology involved in their business or "commercially nonobvious" aspects of their proposed business models, secure in the knowledge that patent remedies like compensatory damages and injunctive relief will be available if the information is used illicitly.[284] That said, other options already exist that perform a similar function, such as non-disclosure agreements and reputational concerns that restrict investors' decisions to copy.[285] Which form of protection is preferable from the social perspective remains unresolved.

Additionally, according to signal theory, commercialization patents could reduce informational asymmetries between investors and entrepreneurs. Simply owning or having a license to a commercialization patent might lead investors to give entrepreneurs attention they might not otherwise get. However, as mentioned, the extent to which patent signals are adhered to by investors, and whether patent signals have intrinsic value, is debated, with empirical studies coming to divergent conclusions.[286] 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 reduce the transaction costs created by existing patents on inventions. Yet, obviously, commercialization patents themselves would create entirely new transaction costs for

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[279] See ADAM SMITH, Lectures on Jurisprudence 82-83, quoted in MERGES & DUFFY, supra, at 7, n. 20

[280] 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 Abrams & Polk Wagner, *Poisoning the Next Apple? The America Invents Act and Individual Inventors*, 65 STAN. L. REV. 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.)

[281] See PartII.C.3.

[282] On "ex post" incentives, see Hemel & Ouellette, supra, at 333-34 (explaining hat with ex post patents money changes hands only after a successful product is developed.)

[283] Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, supra, at 1-5.

[284] Kitch, supra, at 277; Merges, *A Transactional View of Property Rights, supra*, at 1500-1513.

[285] See Burstein, supra, at 262-74 (discussing various non-IP strategies for resolving the disclosure paradox.)

[286] *See* Graham et al, *supra*, at 1288-1314 (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 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 are not relied on to the same degree by investors especially compared with other indicators like first-mover advantage).

innovators other than commercialization patent holders who wish to enter the market.[287] These new transaction costs could outweigh any benefit. To make this concrete, imagine that, instead of raising all its money from private investors, Uber received a commercialization patent in 2000.[288] Even if it lasted for only five to eight years, Uber's patent might mean we have no competitors like Lyft to drive down the price of ride-sharing.

Thus, even if invention patents are hindering commercialization by start-ups and small businesses, as some commentators suggest,[289] introducing new exclusive rights for commercializers seems like a blunt tool for confronting this problem. Private ordering solutions in the form of patent pools and standard-setting organizations (which Merges calls "collective rights organizations") have emerged in significant number to make licensing patents cheaper and less time consuming.[290] Similar organizations may continue to significantly reduce the problem of over-rewarding IPR regimes. Moreover, under the Supreme Court's holding in *Ebay* (2006), courts already have discretion in awarding patent injunctions, especially when non-practicing entities are involved.[291] Finally, there are possibilities for achieving a similar goal that do not involve creating new exclusive rights, such as a revived "paper patent" doctrine that disfavors un-worked patents in favor of worked patents.[292]

B. Commercialization Awards

1. Targeting the Marginal Commercializer

Commercialization awards use a different strategy to resolve commercialization market failures. They reduce the risk entailed in investing in technology ventures by supplying *ex ante* funding in the form of cash, loan, or equity, usually requiring equal co-investment from private sources.[293] Unlike commercialization patents, awards provide capital

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[287] Merges, Of Property Rules, Coase, and Intellectual Property, supra, at 2654-60. See also Scotchmer, Standing on the Shoulders of Giants, supra, at 29-41 (arguing that patents may reduce incentives for second generation innovations).

[288] 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 they want to go. *See* Steven Greenhouse, Tax Driver Solidarity: Pinched by Ride-Sharing Services, Cabbies Seek a National Union, THE NEW YORK TIMES, June 6, 2014. *See also* Michael de la Merced, Uber Attains Eye-Popping New Levels of Funding, THE NEW YORK TIMES, June 6, 2014 (reporting Uber has raised $1.2 billion from investors and has a $17 billion valuation.)

[289] See, e.g., Colleen Chien, *Start-ups and Patent Trolls*, STAN. TECH. L. REV. (2012); James Bessen & Michael J. Meurer, *The Direct Costs from NPE Disputes*, 99 CORNELL L. Rev. 387 (2014.) But see David Schwartz & Jay Kesan, *Analyzing the Role of NPE's in the Patent System*, Essay, 99 CORNELL L. REV. 426 (2014.)

[290] *See* Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CAL. L. REV. (1996). *See also* Mike Mattioli, *Communities of Innovation*, 106 NORTHWESTERN L. REV. 103, 110-116 (2012) (using case studies of various patent pools to investigate Merges' thesis about collective rights organizations empirically.) See also Gupta, supra, at 827-58 (discussing private ordering solutions.)

[291] See Ebay, 396-97 (holding that courts should not automatically grant injunctions in patent cases.)

[292] *See* Duffy, *Reviving the Paper Patent Doctrine*, supra, at 1359. See also Abramowicz & Duffy, *The Inducement Standard of Patentability*, supra, at 1672 (arguing that the standard of patentability should take into account the extent to which an invention achieved commercial success through some level of effort by the patent holder, while "[e]vidence of commercialization by others would point in the opposite direction [invalidity or narrower scope] if it seemed that the others had developed the invention independently, another secondary consideration.")

[293] On matching, see Part III.B.6.

now in exchange for the promise to exercise best efforts to commercialize in the reasonably near future.[294] Moreover, they specifically target entrepreneurs, supplying research and operating capital only for companies experiencing funding gaps during ESTD: the stage between invention and the point at which an invention has sufficient commercial applications and business potential to attract private investors independent of government support.[295] Along with the government's capital input, awards may produce a "certification effect," making it easier for recipients to raise money following the award.[296]

For a large corporation deciding whether to invest in developing and marketing an innovation, an award of $10,000-$1 million would probably not make much difference. But for an entrepreneur seeking small amounts of funding to do ESTD and continue operations before profitability, this amount could represent a critical input, as in the case study described in Part III. Thus, not only do commercialization awards accelerate the pace at which innovations reach the public and the pace at which information enters the public domain, they also direct incentives specifically at marginal commercializers and at the sector of the business community that is thought to be most innovative.

2. But Can Government Do It?

On the other hand, commercialization awards have significant downsides. As discussed in Part III.D., we may be suspicious of government's ability to value innovations' commercial potential and direct awards to deserving entities. As explained, some evidence suggests it is not impossible for the government to do a decent job at awarding companies experiencing market failure through small expenditures of taxpayer funds – assuming a program design that includes, at minimum, a portfolio strategy; strict private sector matching requirements; and strictly enforced public disclosures of expenditures.[297] Government need not be an expert investor to do this effectively. But we can certainly expect some deadweight loss.

But, as scholars like Kapczynski and Frischmann emphasize, we must consider the alternative. Commercialization patents rely on markets versus government to price innovation.[298] Yet they also produce deadweight loss for consumers, at least in the absence of perfect price discrimination.[299] As Hemel and Ouellette's comparative analysis of innovation incentives suggests, the question is whether the money (the "tax") should come from the general public or from specific consumers who use innovations once commercialized.[300] Unlike mere invention, which is thought to *indirectly* benefit society through market mechanisms such as patent licensing and nonmarket spillovers,[301]

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294 On "ex ante" incentives like grants, see Hemel & Ouellette, supra, at 333-34.

295 Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, *supra*, at 1. *See also, e.g.,* Zhao & Ziedonis, supra, at 4-5 (explaining goal of awards to alleviate capital constraints for entrepreneurs.)

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

297 For Ibrahim's disagreement, see Ibrahim, supra, at 737-38.

298 *See* Gallini & Scotchmer, *supra*, at 70; Scotchmer, INNOVATION AND INCENTIVES, supra, at 85.; Hemel & Ouellette, *supra*, at 327.

299 See Kapcsynski, supra, at 979-80 (discussing deadweight loss of IPR.)

300 Hemel & Ouellette, supra, at 12 ("Patents are, in substance, a sales tax combined with a prize: the sales tax is imposed on users of the patented product, and the prize is reaped by the patentee in the form of supracompetitive profits.")

301 For discussion of the private and social returns from innovation, *see, e.g.*, Hall, *supra*, at 145-59. *See also* David Mowery & Arvids Ziedonis, *Markets versus Spillovers in Outflows of University Research*, July 25, 2014, (unpublished

commercialization of inventions can be expected to produce *direct* economic benefits in the near term, particularly for the region in which commercialization occurs.[302] Thus, having taxpayers 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.[303]

A second potential downside is that, because commercialization awards do not create exclusive rights in new information whose scope is defined by a specification, they do not necessarily incent or permit free disclose of all information related to practicing and marketing an invention and do not create a property-rights-based mechanism for transferring and entering business deals related to that information.[304] 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.[305] This information will be free for others to copy and use as soon it is disclosed to investors and put into public use. Therefore, it may be difficult and financially unappealing for commercializers to disclose and transfer new information they derive through the process of commercialization itself.

That said, I am skeptical of the relevance of this objection in this context. First, as Abramowicz and Duffy point out, much of this information can already be protected by invention patents for business method.[306] Moreover, as Burstein recently argued, inventors do use other means besides IP, such as trade secret, contracts, and social norms, to protect disclosures during fundraising.[307] Second, assuming the purpose of commercialization patents is to provide exclusive rights "in exchange for the commitment to make and sell a substantially novel product,"[308] 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. On the other hand, if the goal is to incent the generation, disclosure, and transfer valuable information related to market experimentation, then new forms of IPR specifically for "commercially nonobvious" information might be warranted, as Abramowicz and Duffy suggest. Of course, as Sichelman notes, administering such a system would come with the same downside as commercialization awards: it would require government (here, the Patent Office) to "make 'judgments about market viability' and other aspects of commercialization with which the

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paper) (discussing the channels through which university research is thought to contribute to technological innovation and economic development, including, broadly, "market-mediated channels" such as patent licensing and consulting arrangements, and "non-market channels," i.e. spillovers, that benefit other firms without compensation.)

[302] On expected economic benefits of commercialization for the region in which it occurs, see, e.g., McGuire, supra, at 420-21.

[303] *See, e.g.,* Cooter, THE STRATEGIC CONSTITUTION 105-106 (2000) (discussing taxation for national versus local public goods.)

[304] On this perceived benefit of patents, see Kieff, supra, at 703.

[305] *See* Duffy, *Reviving the Paper Patent Doctrine*, *supra*, at 1395 (discussing Michael Polyani, THE TACIT DIMENSION 4 (1966) (suggesting that people know more than they can communicate to others).)

[306] Business method patents cover far more than invention already. *See* Abramowicz & Duffy, *supra*, at 342, 405-407.

[307] *See* Burstein, *supra*, at 248-55 (challenging the assumption that information is inherently nonexcludable without patents.)

[308] See Sichelman, supra, at 341.

Patent Office has no expertise."[309] Government might as well continue providing small amounts of direct financing for entrepreneurs developing promising inventions.

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.[310] However, as explained, I am not convinced this requires any new legislative solution in light of private ordering solutions and *Ebay's* discretionary injunction rule or other court-driven mechanisms.

CONCLUSION

The main goal of this Article has been to compare two solutions to commercialization market failures: spillovers that reduce investment in technologies that implicate significant commercial risk; transaction costs related to IPR licensing; and information and trust asymmetries that restrict entrepreneurs' access to capital markets. If preventing "free-riding" by competitors on information produced during commercialization is innovation policy's main concern, then commercialization patents are the better incentive because they create property rights in information. However, if supporting entrepreneurship and more immediate economic spillovers is the main concern, then commercialization patents are probably not the best solution. Not only do they create new transaction costs in commercial markets, but they provide no funding for entrepreneurs experiencing funding gaps during ESTD and early-stage operations. Instead, they rely primarily on investors' future and highly uncertain expectation of market power and on the highly debatable value of patents as "signals."

In contrast, commercialization awards, including federal SBIR awards and various state commercialization award programs, concertedly target market failures related to entrepreneurship by providing small infusions of capital for inventors and start-ups. They do not create deadweight loss in the form of legally sanctioned market power; they do not introduce new transaction costs into IP licensing markets; and they can be obtained for all types of technological and commercial innovations, so long as they have near-term commercial potential. Contrary to some critics' assessments, award recipients need not – and indeed *should not* – be the "best" companies that private investors would have supported without government involvement. Instead, commercialization awards target marginal commercializers: inventors, small businesses, and start-ups that are unable to obtain private funding without some government assistance. Given that assisting entrepreneurs caught in the so-called Valley of Death is one of the major goals of U.S. technology policy, commercialization awards seem like an appropriate policy choice when compared to alternatives.[311]

Commercialization awards do come with significant downsides. They draw away from valuable taxpayer revenues and can produce deadweight loss in cases where the government completely fails to accurately value the technological or commercial merit of an innovation or gives money to an inventor that would have gotten it anyway.[312] Government's

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[309] Id. at 397 (explaining why subject matter for commercialization patents should not include market innovations.)

[310] See Sichelman, supra, at 406-407 (describing immunities commercialization patents would produce as against invention patents.)

[311] Auerswald & Branscomb, BETWEEN INVENTION AND INNOVATION, supra, at 35

[312] Again, deadweight loss occurs when losses to buyers and sellers that result from a tax or a subsidy exceed the revenues raised or the benefits obtained from the subsidy. See Mankiw, supra, at 159.

miscalculations could lead to various market inefficiencies, including distortion of private investment decisions and foregone tax revenues that could have gone towards government projects like education. Good design is the key to making commercialization awards work. As explained in Part III.B., government uses professional management, staged financing, and private sector matching requirements to improve valuations and increase the likelihood that awards go to marginal commercializers. Of course these mechanisms will not be perfect.[313] But no innovation incentive is perfect.

In light of the divergent costs and benefits of commercialization patents and commercialization awards, I would ordinarily conclude that a "mixed incentives" model is the ideal solution.[314] However, government has already adopted a bifurcated system for resolving market failures related to commercialization that relies on patents on inventions (and slightly beyond[315]), combined with supplemental financing for small businesses and entrepreneurs. Separate forms of exclusive rights for rewarding purely commercial risk have never been sanctioned in the U.S.[316] Although it could potentially be useful to experiment with introducing commercialization patents in limited regions in order to test the theory,[317] I suggest holding back on definitively introducing an unproven legal innovation given that commercialization awards already exist at various levels of government. Lerner, Feldman, Ziedonis, and others are doing substantial empirical work in this area and seeking ways to improve existing programs.[318] Legal scholars who know the laws related to IP and innovation policy could assist in these efforts.

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313 See, e.g., Ibrahim, supra, at 737 (discussing flaws of public versus private VC models.)

314 See Frischmann, supra note 88, at 349–50 (noting that intellectual property rights are not necessarily the best tool for promoting innovation and should be mixed with other mechanism of promotion); Hemel & Ouellette, supra note 103 (arguing that which incentive to adopt depends on a range of factors including the government's ability to evaluate projects, risk aversion of inventors, efficiency of capital markets, deadweight losses resulting from taxation and monopoly, administrative costs, political economy considerations, and distributive justice considerations.)

315 Abramowicz & Duffy, *supra*, at 400-407 (discussing ways that patents already reward "commercially nonobvious" innovations like business methods.) Design patents also provide incentives to take commercial risks. *See, e.g.,* Peter Lee & Madhavi Sunder, *Design Patents: Law Without Design*, 291 17 Stan. Lech. L. Rev. 277, 291 (2013) (discussing various justifications for deign patents, including incentive to develop "new designs and consumer experiences[.]")

316 As noted *supra*, Alexander Hamilton supported "exclusive privileges," along with "pecuniary awards," for "new intentions and discoveries at home, and the introduction into the United States of such as may have been made in other countries," but ultimately rejected his own proposal to the extent it went beyond patents for inventions under the Patent Act. *See, e.g.,* Hrdy, *Do We Need More IP to Promote Commercialization?,* WRITTEN DESCRIPTION, March 2, 2014, http://writtendescription.blogspot.com/2014/03/do-we-need-more-ip-to-promote.html

317 *See Ouellette, Patent* Experimentalism, *supra* (proposing model for experimenting with commercialization patents.)

318 *See, e.g.,* Lerner, BOULEVARD OF BROKEN DREAMS, supra, at 181-90; Feldman & Lanahan, *State Science Policy Experiments*, *supra*, at 1 (exploring efficacy of state programs.)

APPENDIX: COMPARING RESPONSES TO COMMERCIALIZATION MARKET FAILURES

Market Failure:	**Commercialization Spillovers**	**Transaction Costs in IP Licensing**	**Capital Constraints for Entrepreneurs**
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 disclosures with property rule Opportunity for significant *ex post* market power increases *ex ante* chance of financing Patent "signals" reduce information asymmetries
COMMERCIALIZATION AWARDS	Government matching of private investment reduces risk of commercializing inventions No new property rights in information	No new legislative solution (but *Ebay* already makes injunctions conditional; and paper patent doctrine can be introduced without	Rely on contracts and norms to protect disclosures *Ex ante* awards supply funding for ESTD* and operating capital

		creating new IPR)	Government "certifications" reduce information asymmetries

* 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 (Auerswald & Branscomb 2002)