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# PATENT NATIONALLY, INNOVATE LOCALLY

*Camilla A. Hrdy*[†]

## ABSTRACT

Anxiety over the efficacy and fairness of the patent system has spawned a variety of proposals to rely more heavily on direct public subsidies for innovation, such as research grants and tax incentives. Applying economic theories of federalism, this Article shows that these public finance alternatives to IP—which I call "innovation finance"—should sometimes be the responsibility of *subnational* governments such as states and cities, rather than the federal government. The economic theory of federalism prescribes that public goods should be supplied by the smallest jurisdiction that internalizes the costs and benefits of its actions without creating externalities (spillovers) for other jurisdictions. States cannot reliably internalize the benefits of patent regimes that require significant public disclosure of information. But they can internalize many of the economic benefits of direct public spending on innovation. Indeed, a long line of theoretical and empirical research suggests that the economic benefits of innovation—mainly, high-salaried employment and long-term economic growth—remain highly concentrated in certain geographic locations. Therefore, optimal allocation of government requires that we presume subnational jurisdiction over innovation finance *unless* significant cross-border spillovers or some other collective action failure indicates that national intervention is necessary. The result should be more effective innovation policies that are tailored to the needs and conditions of disparate geographic regions and the demands of a mobile populace, and more precise clustering of innovation industries across the country. Moving from theory to reality, the Article demonstrates that states *already* provide significant funding for private sector innovation, and that federal funding for research is actually the exception rather than the rule. Lastly, the Article highlights a major weakness of economic federalism theory in this context: it fails to take into account preexisting inequalities among regions that may prevent under-resourced locations from mobilizing effective innovation strategies, thereby locking them out of the competition to grow innovation clusters. I argue that pervasive regional inequality creates an independent basis for federal intervention.

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> The powers delegated by the proposed Constitution to the federal government are few and defined. Those which are to remain in the State governments are numerous and indefinite. The former will be exercised principally on external objects, as war, peace, negotiation, and foreign commerce . . . . The powers reserved to the several States will extend to all the objects which, in the ordinary course of affairs, concern the lives, liberties, and properties of the people, and the internal order, improvement, and prosperity of the State.[1]
>
> – James Madison, *The Federalist* No. 45

> While competition for innovative technologies and services is increasingly global, the context of innovation—and the benefits it brings in economic growth and high value employment—remains local.[2]
>
> – National Academy of Sciences, "Growing Innovation Clusters for American Prosperity"

## I. INTRODUCTION

The core justification for patent law is the notion that human societies thrive on "innovation"—doing things that are new and in some way better than what existed before—and that people and firms will systematically underinvest in innovation absent incentives.[3] But a growing number of academics are dissatisfied with intellectual property (IP) as a solution to the incentives problem, arguing that property rights needlessly raise prices for consumers and hinder future innovation.[4] As a result, these academics argue that patents should be replaced or supplemented by direct public financing for innovation, such as research grants, tax incentives, or public

1. THE FEDERALIST NO. 45, at 292–93 (James Madison) (Clinton Rossiter ed., 1961).

2. CHARLES W. WESSNER (Rapporteur), NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMIES: SUMMARY OF A SYMPOSIUM, GROWING INNOVATION CLUSTERS FOR AMERICAN PROSPERITY 3 (2011).

3. *See infra* Part II.

4. *See generally* Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031, 1058–65 (2005) (discussing five separate costs of IP rights: deadweight loss for consumers, reduced incentives to innovate, rent-seeking, costs associated with patent prosecution and litigation, distorted investment in research and development).

venture capital.[5] I call these public finance alternatives to IP "innovation finance."[6]

Like patents, innovation finance can serve as a regulatory mechanism to more closely align the private value of innovating with the social value of innovation.[7] Government already provides direct financing for innovation in many cases, so why not do so more? For example, rather than allowing unrestricted patenting of life-saving drugs, government could directly fund production and permit copying by generic drug manufacturers or subsidize

5. *See, e.g.,* Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents—Prizes Debate*, 92 TEX. L. REV. 303, 303–04 (2013) (arguing for a pluralistic innovation policy that incorporates patents, prizes, grants, and tax credits); Camilla A. Hrdy, *Commercialization Awards*, 2015 WIS. L. REV. 13, 13–14 (arguing that commercialization awards can in some instances be a more efficient innovation policy tool than commercialization patents); Amy Kapczynski, *The Cost of Price: Why and How to Get Beyond Intellectual Property Internalism*, 59 UCLA L. REV. 970, 970, 1001–02 (2012) (arguing based on efficiency and distributive justice concerns that government should "pay less attention to IP and more attention to its alternatives" such as government procurement); Peter Lee, *Social Innovation*, 92 WASH. U. L. REV. 1, 47–59 (2015) (arguing that many valuable "social innovations" are supported by non-patent incentives including government grants and social capital markets); *see also* Brett Frischmann, *Innovation and Institutions: Rethinking the Economics of U.S. Science and Technology Policy*, 24 VT. L. REV. 347, 376–95 (2000) (developing a framework for evaluating and choosing between different innovation incentives including IP, tax, grants, and procurement, and arguing in favor of a "mixed incentives" policy); Joshua D. Sarnoff, *Government Choices in Innovation Funding (With Reference to Climate Change)*, 62 EMORY L.J. 1087, 1116–23 (2013) (providing a "[t]axonomy of [g]overnment [i]nnovation [f]unding [m]echanisms" including tax and other forms of subsidies); Michael J. Graetz & Rachael Doud, *Technological Innovation, International Competition, and the Challenges of International Income Taxation*, 113 COLUM. L. REV. 347, 350 (2013) (noting that government support for R&D "comes in many forms," including "legal protections for IP" and "tax benefits for both R&D itself and the gains from innovation.").

6. Public financing for innovation was the primary form of innovation incentive explored at the two Yale Law School "Innovation Beyond IP" conferences held in March 2014 and March 2015, respectively. *See also* SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 242–43 (2004) ("[A] single innovation may be funded in two ways: by the public sector out of general revenue, and through proprietary prices under an intellectual property regime."). There are other ways for government to influence innovation besides IP and innovation finance. For instance, government can use regulations that penalize innovators for failing to innovate. *See* Ian Ayres & Amy Kapczynski, *Innovation Sticks: The Limited Case for Penalizing Failures to Innovate*, 82 U. CHI. L. REV. 1781, 1781 (2015) (drawing a distinction between penalties for failure to innovate and incentives to innovate, and arguing that under specific circumstances penalties for failure to innovate can play a valuable role in innovation policy); *see also* Gregory N. Mandel, *Regulating Emerging Technologies*, 1 L., INNOVATION & TECH. 75, 75 (2009) (discussing the challenges of regulating emerging technologies).

7. CHRISTINE GREENHALGH & MARK ROGERS, INNOVATION, INTELLECTUAL PROPERTY, AND ECONOMIC GROWTH 24–25 (2010) (noting that taxes or subsidies can be used to correct negative or positive externalities).

insurance for certain treatments to drive down the price of drugs for consumers.[8] Rather than relying on patents to foster innovation in nanotechnology, governments could offer more direct funding to firms to increase incentives to enter uncertain nanotechnology markets.[9]

Innovation finance is an enticing prospect with a growing number of supporters from both inside and outside the IP field. For example, a Nobel-prize winning economist has concluded that if government has sufficient information and is able to solve the challenge of raising revenues and discriminating between good and bad research projects,[10] the strategy of directly subsidizing innovation would in every case "dominate that of enhancing intellectual property rights."[11] But this discussion is missing a more fundamental issue. Even if public financing for innovation is sometimes fairer and more efficient than IP, it is not clear whether innovation finance should be supplied or administered by the national government or by *subnational* governments such as states, cities, and metropolitan regions.[12] This Article tackles this question and, more broadly,

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8. *See* Amy Kapczynski & Aaron S. Kesselheim, *'Government Patent Use': A Legal Approach to Reducing Drug Spending,* 35 HEALTH AFFAIRS 791, 791 (2016) (arguing government could fund or import generic versions of socially valuable drugs based on its power of sovereign immunity and compensate patent holders under the reasonable compensation mechanism codified in 28 U.S.C. § 1498); Rachel Sachs, *Prizing Insurance: Prescription Drug Insurance as Innovation Incentive*, 30 HARV. J.L. & TECH. (forthcoming 2017), draft available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2767182, at 1 (arguing that prescription drug insurance can be wielded as an innovation incentive to avoid the deadweight loss and distortions created by the patent system).

9. Lisa Larrimore Ouellette, *Nanotechnology and Innovation Policy*, 29 HARV. J.L. & TECH. 33, 36 (2015) (illustrating that in the nanotechnology field governments across the world "have played an essential role not only by funding basic research, but also by crafting infrastructure to lower the barriers to entry, and by providing substantial direct funding to firms to help mitigate the risk of entering uncertain nanotechnology markets").

10. This is a big "if." IP scholars fiercely debate whether and when innovation finance should be preferred. See discussion *infra* Part III.

11. *See* Joseph E. Stiglitz, *Knowledge as a Global Public Good*, *in* GLOBAL PUBLIC GOODS 308, 312 (Inge Kaul et al. eds., 1999) (concluding that "[i]f government could costlessly raise revenues for financing the support and if government were effective in discriminating between good and bad research projects, clearly this strategy would dominate that of enhancing intellectual property rights, for the latter strategy entails static distortions (the monopoly prices associated with patent rights result in prices exceeding marginal costs) and the inefficient utilization of knowledge")). *But see, e.g.*, F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697, 705–17 (2001) (identifying various problems with "reward alternatives" to patents).

12. This Article uses the term "subnational government" in reference to states, cities, and regional governments; and it sometimes use the term "local government" for convenience. But these levels of government are structurally distinct. States have their own constitutions that delegate authority to local governments within their jurisdictions. SANDRA STEVENSON, UNDERSTANDING LOCAL GOVERNMENT 9 (2009) ("Local

the question of which level of government should be responsible for which aspects of innovation policy. The Article concludes that intellectual property law—specifically patent law[13]— should be federal law, but that innovation finance should, with important exceptions, be supplied by the state, city, or other subnational government in which the innovation actually occurs—that is, where the research is performed and commercialized.

In reaching this conclusion, I rely on what Robert Cooter and Neil Siegel call "collective action federalism theory,"[14] which in turn is derived from longstanding economic theories of federalism.[15] Under collective action federalism theory, federal action is justified for resolving a particular public problem only when subnational action produces external costs or benefits for other jurisdictions (externalities or spillovers), and the costs of

governments are completely beholden to state governments for their existence and authority."). This Article does not address the debate among local government law scholars regarding how much power local governments should have vis-à-vis states. *See, e.g.*, Nestor M. Davidson, *Cooperative Localism: Federal-Local Collaboration in an Era of State Sovereignty*, 93 VA. L. REV. 959, 962 (2007) (challenging "the prevailing view of local governments as powerless instrumentalities of the states").

13. This Article does not discuss copyrights and trademarks because the degree to which they operate as innovation incentives is unclear. But the jurisdictional trajectory of state copyrights and trademarks resembles that of patents: they started as state rights and became federal rights as interstate commerce made local protections increasingly infeasible. On remaining state protection for copyright in sound recordings, see Goldstein v. California, 412 U.S. 546, 573 (1973); *see also* Michael Erlinger, Jr., *An Analog Solution in A Digital World: Providing Federal Copyright Protection for Pre-1972 Sound Recordings*, 16 UCLA ENT. L. REV. 45 (2009); Eva E. Subotnik & June Besek, *Constitutional Obstacles? Reconsidering Copyright Protection for Pre-1972 Sound Recordings*, 37 COLUM. J.L. & ARTS 327, 329–30 (2014). On trademark law's jurisdictional trajectory from state to federal rights, see Lee Ann W. Lockridge, *Abolishing State Trademark Registrations*, 29 CARDOZO ARTS & ENT. L.J. 597 (2011); MARK MCKENNA, *Trademark Law's Faux Federalism*, *in* INTELLECTUAL PROPERTY AND THE COMMON LAW (Shyamkrishna Balganesh ed., 2013); Peter S. Menell, *Regulating "Spyware": The Limitations of State "Laboratories" and the Case for Federal Preemption of State Unfair Competition Laws*, 20 BERKELEY TECH. L.J. 1363, 1381–83 (2005). Section V.C.3 discusses trade secret law briefly, noting that trade secret laws are different from patents because they do not mandate disclosure of information that can easily be replicated in other jurisdictions. Thus, unlike patents, trade secrets can be effectively protected without national jurisdiction.

14. Robert D. Cooter & Neil S. Siegel, *Collective Action Federalism: A General Theory of Article I, Section 8*, 63 STAN. L. REV. 115, 119, 137–38, 183 (2010) (explaining the theory of collective action federalism); *see also* ROBERT D. COOTER, THE STRATEGIC CONSTITUTION 105–09 (2000) (discussing national versus local public goods and implications for optimal allocation of governmental authority).

15. Cooter and Siegel acknowledge the economic federalism literature as the major precursor for their theory. *See, e.g.*, Cooter & Siegel, *supra* note 14, at 137 n.102 (noting that an "early formulation" of their approach can be seen in work by economists such as Wallace Oates). For further discussion see *infra* Part IV.

negotiation between subnational governments to resolve these externalities are very high; otherwise, power should be assigned to the smallest unit of government that internalizes the effects of its exercise. Cooter has called this the "internalization principle."[16] With respect to public financing for public goods, the theory prescribes that the federal government should be responsible for supplying "national public goods" like national security, which produce relatively equal benefits for everyone in the country, but that subnational governments should be responsible for supplying "local public goods" like bridges, parks, and fire protection, which mainly benefit the residents of a particular geographic community.[17]

Cooter and Siegel argue that their theory explains and justifies Congress' power under the IP Clause to "promote the Progress of Science and useful Arts" by "securing" the "exclusive Rights" of "Authors and Inventors" to their "respective Writings and Discoveries."[18] "Because the problem of unauthorized use extends across state lines," they write, "the problem is national and Congress is better placed than the states to solve it."[19] But this Article argues that collective action federalism theory and its guiding internalization principle mandate a different conclusion *depending on which type of innovation policy we select*: intellectual property rights or innovation finance. Although Cooter and Siegel are correct that subnational governments cannot generally internalize the benefits of their patent laws because they cannot efficiently prevent imitation and competition within a national marketplace,[20] subnational governments internalize many of the benefits of public spending on innovation.

The common wisdom is that innovation produces significant national and indeed global benefits because knowledge produced in one location inevitably "spills over" to other jurisdictions.[21] But significant empirical and

16. COOTER, note *supra* note 14, at 137; *see also infra* Part IV.

17. *See infra* Part IV.

18. U.S. CONST. art. I, § 8, cl. 8.

19. Cooter & Siegel, *supra* note 14, at 149.

20. Camilla A. Hrdy, *State Patents as a Solution to Underinvestment in Innovation*, 62 U. KAN. L. REV. 101, 111 (2014) ("Given the externalities associated with the creation of new inventions and the difficulty of protecting them in an interstate market—along with the heavy administrative cost of multiple state patent offices—it would be expensive, inconvenient, and socially wasteful if inventors had to rely *solely* on a patchwork of state rights."). *C.f.* John F. Duffy, *Harmony and Diversity in Global Patent Law*, 17 BERKELEY TECH. L.J. 685, 694 (2002) (arguing that "[j]ust as the externalities provide a justification for the existence of a patent system, so too do they provide a reason for [global] harmonization [of patent law]").

21. As David Audretsch and Maryann P. Feldman put it, "there is no reason that knowledge should stop spilling over just because of borders, such as a city limit, state line,

theoretical research shows that the immediate economic impacts of innovation tend to be highly concentrated in the geographic regions in which it occurs.[22] These regions are the so-called "innovation clusters" like Silicon Valley, California and Boston, Massachusetts, where high tech firms and their employees reside, consume local services, and pay taxes.[23] According to the economic federalism literature and the internalization principle, public financing for innovation should arguably come from the specific city, state or other subnational community that captures the economic benefits of innovation. The result should be more investment in the kinds of innovation that benefit particular communities, more efficient clustering of mobile firms and residents into different technology areas, and (a fortunate side-benefit of following the internalization principle) more experimentation in law and policy.[24]

Rather than stopping with this theoretical result, this Article also shows that this conclusion is borne out in practice. Even though states no longer grant patents,[25] states supply significant amounts of funding and tax incentives for research and commercialization.[26] The federal government certainly plays the dominant role in funding basic science with few commercial prospects and research related to national mission areas such as defense and public health, where subnational governments lack sufficient incentives to supply public financing.[27] But the federal government's support for commercialization and innovation outside of these mission areas is comparably minimal.[28] Meanwhile, U.S. states and even some cities are

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or national boundary." *See* David B. Audretsch & Maryann P. Feldman, *Knowledge Spillovers and the Geography of Innovation*, *in* 4 HANDBOOK OF URBAN AND REGIONAL ECONOMICS (2004), http://www.econ.brown.edu/Faculty/henderson/Audretsch-Feldman.pdf, at 6.

22. See discussion *infra* Section II.C.

23. See discussion *infra* Section II.C.

24. See discussion *infra* Section IV.B.

25. *See* Camilla A. Hrdy, *State Patent Laws in the Age of Laissez Faire*, 28 BERKELEY TECH. L.J. 45, 47 (2013) ("Today patent law is purely a federal creature."). For a discussion of the extent to which remaining state law incentives for innovation are preempted by federal law, see Jeanne Fromer, *The Intellectual Property Clause's Preemptive Effect*, *in* INTELLECTUAL PROPERTY AND THE COMMON LAW (Shyam Balganesh ed., 2013); Camilla A. Hrdy, *State Patents as a Solution*, *supra* note 20, at 135–61; Sharon K. Sandeen, *Kewanee Revisited: Returning to First Principles of Intellectual Property Law to Determine the Issue of Federal Preemption*, 12 MARQ. INTELL. PROP. L. REV. 299 (2008).

26. *See infra* Section V.B.2.

27. *See infra* Section V.B.1. On the federal government's role in basic research funding, see generally JOSH LERNER, THE ARCHITECTURE OF INNOVATION: THE ECONOMICS OF CREATIVE ORGANIZATIONS 20–21, 33 (2012).

28. For prior iterations of this observation, see, e.g., LEWIS M. BRANSCOMB & PHILIP E. AUERSWALD, TAKING TECHNOLOGICAL RISKS: HOW INNOVATORS, EXECUTIVES, AND

increasingly financing innovation at all phases of development and in a wide range of technology areas.[29] As this Article documents, states currently spend billions of dollars a year on a wide variety of innovation initiatives, including grants for research, R&D tax credits, venture financing for technology firms, and educational programs, in the hopes that mobile firms will locate and remain in the region.[30]

My conclusion—that patent law should be national but that innovation finance often is and often should be subnational—has serious implications for innovation policy and the IP field. Specifically: if we follow the advice of academics who propose relying on public finance rather than patents, at least some of these incentives should be the responsibility of local governments. My conclusion also has implications for the economic federalism and public finance literature. While knowledge is often cited as an example of a "global public good" that creates significant free-rider problems and thus necessitates national if not international intervention,[31] such statements are contradicted by the reality that, at least within the United States, a not-insignificant amount of funding for knowledge goods comes from local governments. In other words, innovation, and the new knowledge that innovation produces, sometimes behaves more like a local public good than a national public good.

This Article proceeds as follows. Part II discusses theoretical and empirical research suggesting that the immediate economic impacts of

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INVESTORS MANAGE HIGH-TECH Risks 144 (2001) [hereinafter Taking Risks] ("Unlike the states, which are politically quite comfortable competing with one another to attract new business through active programs of R&D subsidies, federal politics views with suspicion government programs to assist individual firms."); *see also* Peter Eisienger, The Rise of the Entrepreneurial State: State and Local Economic Development Policy in the United States 241–65 (1988) (discussing states' commitment to supplying venture capital for small businesses, entrepreneurs, and high-technology enterprises in the 1970s and 80s); Matthew Keller, *The CIA's Pioneering Role in Public Venture Capital Initiatives*, *in* State of Innovation: The U.S. Government's Role in Technology Technical Development 110–11 (Fred Block & Matthew Keller eds., 2011) (observing that public venture capital programs aimed at spurring economic development began at the state level and contrasting this to the federal government's more limited adoption of venture capital initiatives) (citing Eisenger's work).

29. Maryann P. Feldman & Lauren Lanahan, *State Science Policy Experiments*, *in* THE CHANGING FRONTIER: RETHINKING SCIENCE AND INNOVATION POLICY (Adam B. Jaffe & Benjamin F. Jones eds., 2015) (noting that state expenditures on R&D programs at universities alone are now over $3 billion and describing states' increasing expenditures since 1980 on these and other initiatives). For examples of recent state expenditures on science and technology initiatives, see STATE SCI. & TECH. INST., TRENDS IN TECHNOLOGY-BASED ECONOMIC DEVELOPMENT: LOCAL, STATE AND FEDERAL ACTION IN 2012 7–9 (2012), http://ssti.org/sites/default/files/.

30. *See infra* Section V.B.2.

31. *See* Stiglitz, *Knowledge as a Global Public Good*, *supra* note 11, at 310.

innovation—high-salaried employment, more spending on local businesses, increased tax revenues, and a greater store of "local knowledge spillovers"— are both highly localized and heavily concentrated in certain geographic regions within the country. Part III explains the two most common forms of innovation policy intervention—intellectual property and innovation finance—and the costs and benefits of each. Part IV explicates the collective action federalism theory and situates it within the general theory of economic federalism. Part IV then applies the theory to innovation policy and discusses the theoretical benefits, and limitations, of local innovation finance incentives.

Part V illustrates that this theory appears to be a good descriptor of U.S. innovation policy today. In short: modern U.S. patent law is purely national. But outside basic research and selected mission areas, innovation finance is often subnational. While we lack empirical studies demonstrating whether local innovation programs are worth the cost or whether they are superior to alternative federal programs that might be created, economic federalism theory suggests that this allocation of authority could be good for local economies and good for innovation overall. That said, the theory also highlight serious limitations, including lingering externalities and the pernicious threat of persistent geographic inequality. These are potential areas for federal oversight and/or federal subsidy. Part VI summarizes and concludes.

## II. GEOGRAPHICALLY LOCALIZED BENEFITS OF INNOVATION

The common utilitarian conception of the role of patents and of intellectual property rights generally is that IP encourages people and firms to innovate despite the difficulty of appropriating the full value of the benefits confer their innovations on society.[32] "Innovation"—the application of new ideas to products, processes, or other aspects of a productive enterprise in a way that creates value for creators or

32. R. Polk Wagner, *Information Wants to Be Free: Intellectual Property and the Mythologies of Control,* 103 COLUM. L. REV. 995, 1002 (2003) ("Intellectual property laws . . . allow for the creators of intellectual property to individually capture value associated with the information they present to the world; this is, after all, the fundamental utilitarian bargain, a reward for the creativity or innovation that society wants."). *But see* Brett M. Frischmann & Mark. A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 258 (2007) ("[T]here is no reason to think that complete internalization of externalities is necessary to optimize investment incentives . . . . Spillovers do not always interfere with incentives to invest; in some cases, spillovers actually drive further innovation.").

consumers[33]—may benefit society at large in many ways. As patent law scholars frequently emphasize, innovation generates new knowledge that in turn produces future innovation.[34] Indeed, according to famous studies by Edwin Mansfield, the majority of the benefits of particular innovations have come from developments made by others after the initial adoption.[35] In the more immediate term, innovation leads to exciting new products and services (at least for consumers who can afford them),[36] greater profits and growth prospects for firms (producer surplus), and potentially quite significant financial savings for consumers (consumer surplus).[37] Innovation can also have more pervasive and long-term impacts on human wellbeing. Innovation leads to higher-paying jobs, at least for some kinds of workers,[38] and is believed to spur economic growth over time. As Josh

33. Like other recent IP scholarship, this Article departs from the narrow definition of innovation used in patent law; it relies on the definition of innovation adopted by many economists, whose major concern is the impact of innovation on the economy and general wellbeing. *See* GREENHALGH & ROGERS, *supra* note 7, at 4. For an alternative definition of innovation commonly used in schools of information and communication, see EVERETT ROGERS, DIFFUSION OF INNOVATIONS 36 (2003) ("An *innovation* is an idea, practice, or object perceived as new by an individual or other unit of adoption.").

34. *See, e.g.,* Wagner, *supra* note 32, at 1001–02 ("Creation begets more creation; invention leads to further invention.").

35. *See* Edwin Mansfield, *How Rapidly Does New Technology Leak Out?*, 34 J. INDUS. ECON. 217, 217 (1985); *see also* Frischmann & Lemley, *supra* note 32, at 268 (noting that "[s]tatistical evidence repeatedly demonstrates that innovators capture only a small proportion of the social value of their inventions").

36. The commercial fruits of innovation may be protected by IP or other forms of market power that limit competition. Some consumers may therefore be priced out. See discussion of deadweight loss *infra* Section III.B.1.

37. Consumer surplus is technically defined as the difference between the amount a buyer is willing to pay for a good and what they actually pay. *See* GREGORY MANKIW, PRINCIPLES OF MICROECONOMICS 137 (2010). For example, if an innovation in production allows a company to reduce the costs of producing a popular product and leads the company to lower prices, some consumers will pay less for the product than they can afford to pay. *See* GREENHALGH & ROGERS, *supra* note 7, at 12–14 (discussing the effects of innovation on consumers); Frischmann & Lemley, *supra* note 32, at 268 (discussing consumer surplus as a form of spillover generated by innovation). But importantly, innovation does not necessarily translate into consumer surplus, especially if firms have significant market power. For instance, through intellectual property rights, lead-time advantage, or secrecy, firms can keep prices high and experience the innovation's value entirely through profits (producer surplus). SCOTCHMER, *supra* note 6, at 263 (discussing the relationship between, economic growth, consumer surplus, and IP); *see also supra* MANKIW, at 141 (defining producer surplus as the amount a seller is paid for a good minus its costs of production).

38. On the complex relationship between technological innovation and employment, see ERIK BRYNJOLFSSON & ANDREW MCAFEE, RACE AGAINST THE MACHINE 36–52 (2011). *See also, e.g.,* Vincent Van Roy, Daniel Vertesy, & Marco Vivarelli, *The Job-Creation Effect of Patents: Some Evidence from European Microdata* (working paper, Apr.

Lerner puts it, "[i]nnumerable studies have documented the strong connection between new discoveries and economic prosperity across nations and over time. The relationship is particularly strong in advanced nations—that is, countries that cannot rely on copying others or on a rapidly increasing population to spur growth."[39]

But the economic impacts of innovation on society are not equal across geographic regions. To the contrary, a long line of theoretical and empirical research suggests that, even if innovation ultimately produces national and even global economic benefits, innovation's major economic impacts are often highly localized. Even within a nation, *even within a state*, many of the concrete economic benefits of technological advance—new sources of profits and tax revenues, new forms of employment, and higher worker wages—are "overwhelmingly concentrated in a small number of geographic locations."[40] These lucky winners are the "innovation clusters": regional economies made up of a critical mass of firms, institutions, and highly skilled talent whose core activities involve high levels of innovation.[41]

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2016) (finding that the positive impact of employment is statistically significant for firms in the high-tech manufacturing sector, but not significant in low-tech manufacturing and services), http://ssrn.com/abstract=2770525 (last visited May 22, 2016), at 1.

39. LERNER, ARCHITECTURE OF INNOVATION, *supra* note 27, at 16 ("Since the pioneering work of Moses Abramowitz and Robert Solow in the 1950s, we have understood that technological change is critical to economic growth: innovation has not just made our lives more comfortable and longer than those of our great-grandparents, but has made us richer as well."); *see also* Graetz & Doud, *supra* note 5, at 348 (noting that it is "clear and essentially uncontested among economists" that technological innovation is important to economic growth). For further discussion of the impacts of innovation on economic growth at the national level, see, for example, William Hubbard, *Competitive Patent Law*, 65 FLA. L. REV. 341, 349–52 (2013) (discussing the impact of domestic innovation on the United States' competitiveness in the global economy).

40. *See* ENRICO MORETTI, THE NEW GEOGRAPHY OF JOBS 73–120 (2012) (documenting the divergent impact of the innovation sector on geographically distinct regions in the United States). As Moretti puts it,

> [i]nnovation creates enormous social benefits, in the form of new drugs, better ways to communicate and share information, and a cleaner environment. These benefits are diffuse, in the sense that consumers all over the world can enjoy them. But innovation also creates benefits in the form of new and better jobs. These benefits are overwhelmingly concentrated in a small number of geographic locations.

*Id.* at 81; *see also*, *e.g.*, David Ibrahim, *Financing the Next Silicon Valley*, 87 WASH. U. L. REV. 717, 719 (2010) (noting that "[h]igh-tech firms are important drivers of U.S. economic growth in today's knowledge economy, but gains from innovation-based economic growth are highly skewed toward a few regions").

41. WESSNER, *supra* note 2, at 3 ("Innovation clusters are regional concentrations of large and small companies that develop creative products and services, along with

### A. CLUSTER THEORY

Generally speaking, clusters are "geographic concentrations of interconnected companies and institutions in a particular field."[42] The core tenet of cluster theory is that when participants in a field, including competitors, workers, and related firms and institutions, locate in the same physical space, they benefit from one another's presence.[43] In 1994, Michael Porter documented a number of industry "clusters" across the United States in a variety of industries, such as microelectronics, biotechnology, aircraft design, casinos, sawmills, clocks, agricultural equipment, and specialty foods.[44]

Although Porter presented the clustering phenomenon as novel—"a kind of new spatial organizational form in between arm's-length markets on the one hand and . . . vertical integration, on the other"[45]—cluster theory is based on the longstanding concept of "agglomeration benefits."[46] The idea

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specialized suppliers, service providers, universities, and associated institutions. Ideally, they bring together a critical mass of skills and talent and are characterized by a high level of interaction among these entrepreneurs, researchers, and innovators."); *see also* MARK MURO & BRUCE KATZ, BROOKINGS, THE NEW 'CLUSTER MOMENT': HOW REGIONAL INNOVATION CLUSTERS CAN FOSTER THE NEXT ECONOMY 11 (2010) ("Regional innovation (or industry) clusters are geographic concentrations of interconnected businesses, suppliers, service providers, coordinating intermediaries, and associated institutions like universities or community colleges in a particular field (e.g., information technology in Seattle, aircraft in Wichita, and advanced materials in Northeast Ohio)."), http://www.brookings.edu/research/papers/2010/09/21-clusters-muro-katz. Other terms used to describe regional economies made up of communities whose core activity involves high levels of innovation include "innovation hubs" and "brain belts." *See* MORETTI, *supra* note 40, at 82–88 (using "innovation hubs"); ANTOINE VAN AGTMAEL & FRED BAKKER, THE SMARTEST PLACES ON EARTH WHY RUSTBELTS ARE THE EMERGING HOTSPOTS OF GLOBAL INNOVATION 1–21 (2016) (using "brain belts").

42. Michael E. Porter, *Clusters and the New Economics of Competition*, HARV. BUS. REV. (Nov.–Dec. 1998), at 78.

43. *Id.* at 81 (asserting that "[b]eing part of a cluster allows companies to operate more productively in sourcing inputs; accessing in formation, technology, and needed institutions; coordinating with related companies; and measuring and motivating improvement"). For a critical view of cluster theory and Porter's work, in particular, see Gilles Duranton, *California Dreamin': The Feeble Case for Cluster Policies*, 3 REV. ECON. ANAL. 3, 3–4 (2011) (arguing that much of the literature on cluster theory lacks theoretical and empirical rigor).

44. Porter, *supra* note 42, at 82.

45. *Id.* at 79.

46. *See* PAUL KRUGMAN, GEOGRAPHY AND TRADE 35–67 (1991) (discussing agglomeration benefits and the phenomenon of localization of industry). On agglomeration benefits generally, see Lee Anne Fennell, *Agglomerama*, 2014 BYU L. REV. 1373, 1378–79 (2014); BRENDEN O'FLAHERTY, CITY ECONOMICS 16–23 (2005); Daniel B. Rodriguez & David Schleicher, *The Location Market*, 19 GEO. MASON L. REV. 637, 639 (2012).

is that firms or individuals operating in a particular industry or trade, be it high technology or shoe-making, benefit when they locate near-by to one another because they can draw on the same markets of specialized labor, the same specialized suppliers and other infrastructure, and can more freely engage in exchange of ideas.[47] As economist Alfred Marshall put it, observing industry localization in the late nineteenth century, when people in the same trade locate near-by, "the mysteries of the trade become no mystery; but are as it were in the air . . . ."[48]

One important result of cluster theory is increased productivity for all members of the cluster and—crucially for this Article—superior capacity to innovate due to locational proximity to others engaged in similar endeavors.[49] Another important result is that members of a particular field should tend to locate in regions in which others in that field are *already located*.[50] On this view, "the presence of a large number of firms and workers acts as an incentive for still more firms and workers to congregate at a particular location."[51] A corollary is that regions in which members of a field are already located *can expect more to follow*.[52] So, for instance, if a single manufacturing company locates in a city, we should expect others companies that make the same product, as well as workers and suppliers, to locate in the same place and thereby benefit from sharing resources, talent, and ideas.[53] This expansion of cluster size should theoretically continue

47. *See* KRUGMAN, *supra* note 46, at 36–38 (quoting and discussing Marshall's classic analysis).

48. *Id*. at 37 (quoting Marshall).

49. *See* Porter, *supra* note 42, at 81–84 (discussing various benefits that result from co-location); *id*. at 83 ("In addition to enhancing productivity, clusters play a vital role in a company's ongoing ability to innovate.").

50. In work that won him a Nobel Prize, Paul Krugman made the case that "increasing returns to scale are in fact a pervasive influence on the economy, and that these increasing returns give a decisive role to history in determining the geography of real economies." *See* KRUGMAN, *supra* note 46, at 10.

51. *Id.* at 66–67.

52. *See, e.g.*, Timothy Bresnahan, Alfonso Gambardella, & AnnaLee Saxenian, *'Old Economy' Inputs for 'New Economy' Outcomes: Cluster Formation in the New Silicon Valleys*, *in* CLUSTERS, NETWORKS, AND INNOVATION 116 (Stefano Breschi & Franco Malera eds., 2005) (arguing that people and firms in the innovation sector choose to locate in regions "where other technology firms are already located" to obtain privileged access to their know-how).

53. *See* Michael Greenstone, Richard Hornbeck & Enrico Moretti, *Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings*, 118 J. POL. ECON. 536, 536 (2010) (estimating the impact of the opening of a large manufacturing plant for incumbent plants in the same county).

until the benefits of co-location are outweighed by the costs, like traffic, crowding, pollution, and high prices for housing.[54]

## B. "INNOVATION CLUSTERS" DISTINGUISHED

Over the years many researchers have focused their attention "on the phenomenon of clusters of *innovation* as distinct from clusters of production activities."[55] These days, it is far more common to see scholarship assessing the role of proximity and agglomeration benefits in high technology clusters like Silicon Valley than in clusters devoted to, say, paper manufacturing.[56]

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54. Mario A. Maggioni, *Mors tua, vita mea? The Rise and Fall of Innovative Industrial Clusters*, *in* CLUSTER GENESIS: TECHNOLOGY-BASED INDUSTRIAL DEVELOPMENT 220–23 (Pontus Braunerhjelm & Maryann P. Feldman eds., 2006) (discussing the effect of agglomeration benefits and agglomeration costs on cluster size).

55. *See* Luigi Orsenigo, *Clusters and Clustering: Stylized Facts, Issues, and Theories*, *in* CLUSTER GENESIS 196, 195–218 (Pontus Braunerhjelm & Maryann P. Feldman eds., 2006). For a discussion of cluster theory, major concepts, and contributions from diverse economic fields, see Stefano Breschi & Franco Malerba, *Clusters, Networks, and Innovation: Research Results and New Directions*, *in* CLUSTERS, NETWORKS AND INNOVATION 1–5 (Stefano Breschi & Franco Malera eds., 2005); *see also* Maryann P. Feldman & Dieter Kogler, *Stylized Facts in the Geography of Innovation*, *in* HANDBOOK OF THE ECONOMICS OF INNOVATION 381, 383–90 (Bronwyn H. Hall & Nathan Rosenberg eds., 2010) (reviewing literature on the spatial concentration of innovation activity in certain regions).

56. For example, there is a vibrant debate in legal scholarship regarding what caused the success of regions like Silicon Valley. Some argue that locational proximity and open flows of people and information contribute to regions' success. *See* ANALEE SAXENIAN, REGIONAL ADVANTAGE: CULTURE AND COMPETITION IN SILICON VALLEY AND ROUTE 128 4 (2d ed. 2006) (discussing different "regional network-based industrial systems" and asserting that "[n]etwork systems flourish in regional agglomerations where repeated interaction builds shared identities and mutual trust while at the same time intensifying competitive rivalries"); *see also* ORLY LOBEL, TALENT WANTS TO BE FREE: WHY WE SHOULD LEARN TO LOVE LEAKS, RAIDS AND FREE RIDING 76–79 (2013) (discussing the role of agglomeration benefits in high-tech economies such as Silicon Valley and asserting that "[s]uccessful regions depend on a population of skilled and talented workers, and in turn these workers learn more quickly when they work in successful areas"). Some argue that law has played a significant role. *See, e.g.*, Anupam Chander, *How Law Made Silicon Valley*, 63 EMORY L.J. 639, 641–42 (2014) (arguing that while standard accounts assert that Silicon Valley's success can be explained by the economies of agglomeration, law—and IP and privacy laws in particular—played a more significant role in Silicon Valley's rise and its global success than has been previously understood); LOBEL, *supra* note 56, at 75 (asserting that "[t]he research points strongly to the many benefits of weaker noncompetes," and that "more competition and less control of talent flow encourage job growth, start-ups, and regional development"). Others disagree with this conclusion. *See* Jonathan M. Barnett & Ted Sichelman, *Revisiting Labor Mobility in Innovation Markets*, working paper (2016) (critically examining the evidence behind the assumption that legal regimes that enforce contractual and other limitations on labor mobility deter technological innovation), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2758854 (last visited Nov. 3, 2016).

So what makes innovation clusters different? At first glance, the agglomeration benefits that drive localization in high-tech clusters like Silicon Valley appear quite similar to those that drive localization in industries that engage in little research.[57] The same factors—sharing inputs like suppliers and infrastructure and the ability to draw on the same pools of specialized labor—might explain location decisions and resulting increases in productivity in either case. As Krugman puts it, discussing the Silicon Valley and Route 128 success stories, "[t]his is just the labor pooling story; the fact that the skill involves high technology, rather than shoemaking or tufting, may be of secondary importance."[58]

But some argue innovation benefits more from proximity than rote production activities, making co-locating even more important and magnifying the benefits of co-location for all members of a cluster.[59] The reason for this is said to be linked to Marshall's observation that locational proximity gives those in the area—and only those in the area—privileged access to knowledge and information that is, so to speak, "in the air."[60] Since Marshall's work in the late nineteenth century, many scholars have studied the particular role in regional economies of what are now commonly called "local knowledge spillovers": defined as " 'knowledge externalities bounded in space,' which allow companies operating nearby important knowledge sources to introduce innovations at a faster rate than rival firms located elsewhere."[61] Local knowledge spillovers can encompass a broad range of knowledge and information, including "tacit" know-how required to practice science-based inventions,[62] informal "know-how trading"

57. *See* KRUGMAN, *supra* note 46, at 63–67.

58. *See* KRUGMAN, *supra* note 46, at 65.

59. *See, e.g.*, Luigi Orsenigo, *Clusters and Clustering*, *in* CLUSTER GENESIS: TECHNOLOGY BASED INDUSTRIAL DEVELOPMENT 196 (Pontus Braunerhjelm & Maryann P. Feldman eds., 2006) (discussing research in the geography of innovation that suggests "innovation is more spatially concentrated than production activities"); *see also* Feldman & Kogler, *supra* note 55, at 385 ("Innovation is more geographically concentrated than production. Even after controlling for the geographic distribution of production, innovation exhibits a pronounced tendency to cluster spatially.").

60. KRUGMAN, *supra* note 46, at 37 (quoting Marshall).

61. *See, e.g.*, Stefano Breschi & Francesco Lissoni, *Knowledge Spillovers and Local Innovation Systems: A Critical Survey*, Liuc Papers n. 84, SERIE ECONOMIA E IMPRESA (Mar. 2001), at 1, http://www.biblio.liuc.it/liucpap/pdf/84.pdf. For a literature review, see *id.* at 1–10. *See also* GREENHALGH & ROGERS, *supra* note 7, at 204–05 (discussing various studies suggesting knowledge flows occur more rapidly in proximity despite improvements in distance communication).

62. MICHAEL POLYANI, THE TACIT DIMENSION (1966) (discussing science-based knowledge that can only be learned through personal exchange and practice).

between employees at different firms located in the same area,[63] and—most broadly—what Eric Von Hippel calls "sticky information."[64]

Unlike Kenneth Arrow, who assumed that "[t]he cost of transmitting a given body of information is frequently very low," Von Hippel argues that some information is simply "sticky," meaning it cannot easily be transmitted or cannot be transmitted without incurring significant costs.[65] The degree of stickiness depends on various factors, such as the geographic significance of the innovation and how much tacit science-based knowledge is involved that cannot be easily be codified.[66] The point is that when the cost "to acquire, transfer, and use information" is high, then it may be more cost-effective to collocate the problem-solvers (people) and the resources required to solve the problem, such as factories, equipment, and natural resources, in a single location.[67] Some hypothesize that the stickiness of *highly technical* information, in particular, explains why companies wishing to license inventions from universities tend to locate nearby to the university,[68] why corporate labs are often designed to bring many experts together into one place,[69] and why firms in fast-paced fields tend to locate nearby to their direct competitors.[70]

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63. Informal know-how trading refers to accumulated practical skills and proprietary information routinely and informally traded between innovators at different firms, even rivals. Von Hippel has conducted a case study of process know-how trading in the U.S. steel industry. *See* ERIC VON HIPPEL, THE SOURCES OF INNOVATION 6, 76–77 (1988).

64. Eric von Hippel, "*Sticky Information" and the Locus of Problem Solving Implications for Innovation*, 40 MGMT. SCI. 429–39 (1994), available at http://web.mit.edu/people/evhippel/papers/stickyinfo.pdf; *see also* David Teece, *The Strategic management of technology and intellectual property*, *in* COMPETING THROUGH INNOVATION: TECHNOLOGY STRATEGY AND ANTITRUST POLICIES 3–30, 5–9 (David Teece ed., 2013) (discussing the relationship between the transferability of information and companies' ability to exclude and appropriate the value of information).

65. *Id.* at 429 (quoting Kenneth Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY 609, 614–15 (1962)).

66. *Id.* at 429–39.

67. *Id.* at 429.

68. *See* Peter Lee, *Transcending the Tacit Dimension: Patents, Relationships, and Organizational Integration in Technology Transfer*, 100 CALIF. L. REV. 1503, 1536–40 (2012) (discussing the importance of geographic proximity in licensing technology generated at universities and citing empirical studies purporting to confirm the role of proximity in capturing university knowledge spillovers).

69. LERNER, THE ARCHITECTURE OF INNOVATION, *supra* note 27, at 21–23 (explaining how the need to combine many experts and the importance of proximity for encouraging knowledge flows can affect corporate structure of corporate research labs).

70. Porter, *supra* note 42, at 83 (arguing that clustering plays a vital role in companies' "ongoing ability to innovate" because companies within clusters can obtain important information more quickly).

### C. THE BENEFITS OF INNOVATION FOR THE LOCAL ECONOMY

There is also reason to believe that the economic gains for the surrounding community are more extensive in the "innovation sector" than in other industries.[71] There are three main reasons for this. First, as just explained, innovation is thought to benefit more from locational proximity than non-innovative production. This means that high-tech firms tend to be located nearby to one another, and that once high-tech companies cluster in an area, others are likely to follow.[72]

Second, companies in the innovation sector tend to make higher profits because of the way they make their money.[73] By definition, an innovation must be to some degree *novel*.[74] This novelty feature is significant, economically speaking, because—while it may require significant up-front investment—novelty, once achieved, allows innovators to command market power and therefore to charge above marginal cost (more than it costs to produce one additional unit of a good or service.)[75] This means higher profits, which can be distributed to owners or funneled into further research or employee wages.[76] Higher profits also means innovators will likely pay more in taxes.[77] As a result, innovative industries' impact on producers,

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71. The following section distills many of the points made by Enrico Moretti in the second chapter of his 2012 book, *The New Geography of Jobs*. *See* MORETTI, *supra* note 40, at 45–72. For Moretti, defining features of the "innovation sector" include that firms in the sector rely on innovation to make their profits; the innovation sector firms often perform significant research up front; and they tend to "make intensive use of human capital and human ingenuity." *Id.* at 55, 67, 48.

72. MORETTI, *supra* note 40, at 62 ("This clustering effect also exists in manufacturing, but it is particularly strong in high tech . . . .").

73. *Id*. at 67 ("Innovation industries are fundamentally different from all other industries in how they make their profits.").

74. An innovation need not be universally novel. It need only be new to a firm and new to some geographic market. *See* GREENHALGH & ROGERS, *supra* note 7, at 5 ("We define an innovation as new to the firma and new to the relevant market.").

75. *See* GREENHALGH & ROGERS, *supra* note 7, at 9–12 (discussing the effect of innovation on a producer's ability to charge above marginal cost); *see also* MANKIW, *supra* note 37, at 268, 303–08 (defining marginal cost as the increase in total cost that arises from an extra unit of production, and explaining that in competitive markets price equals marginal cost, but that in monopolized markets price exceeds marginal cost).

76. *See* GREENHALGH & ROGERS, *supra* note 7, at 11–12 (explaining that when a monopolist is threatened with entry, an innovation can lower prices and benefit consumers while also leading to higher profits). Obviously, when the innovation is protected by a patent this effect is magnified. *See* MANKIW, *supra* note 37, at 309–10 (explaining that a patent enables the manufacturer of a pharmaceutical drug to charge above marginal cost and thereby increase profits until the patent term runs out).

77. That said, in practice many nations adopt tax breaks for IP owners that locate intangible assets in the jurisdiction rather than taxing them. For example, the increasingly

consumers, workers, and the overall economy can be far greater than in non-innovative industries.[78]

Third, innovative firms tend to hire high-skilled workers that are in lower supply and thus in high demand—meaning they pay higher wages.[79] As Erik Brynjolfsson and Andrew McAfee explain, college educated workers have seen significant gains in their salaries over the past four decades, while wages for the less educated have stagnated. [80] The reason, they argue, is that while low-skill jobs such as traditional manufacturing can be delegated to machines or to humans receiving very low wages, more complex and creative operations like science, programming, management, or marketing decisions "remain the purview of humans."[81] The more educated, skilled, and creative humans are, the higher they are in demand within innovation-intensive industries, and the more attractive their salaries must be.[82] In other words, technological advance increases the price (wages) of high-skilled workers as compared to low-skilled workers.[83]

In new research, economist Enrico Moretti has shown that people living in "brain hubs"—metropolitan areas with higher shares of college-educated workers and often higher shares of patents—do in fact have higher salaries.[84] Specifically, "college graduates in brain hubs make between $70,000 and $80,000 a year, or about 50% more than college graduates in the bottom group."[85] Importantly, these gains are not restricted to innovator firms and high-skill employees. According to Moretti, innovation comes with a strong "multiplier effect": economic gains for everyone located in

common "patent box" offers a preferential tax rate for patent income. *See* Graetz & Doud, *supra* note 5, at 362–75 (discussing patent boxes in Europe and a proposed patent box in the United States). Also, IP owners may manage to avoid paying taxes on their IP by shifting their intangible assets to foreign jurisdictions. *Id*. at 399–401 (noting that companies use income-shifting techniques to "deflect IP income to low- or zero-tax countries even in circumstances where the value of the IP was created in the United States and the resulting products are sold in the United States").

78. *See* MORETTI, *supra* note 40, at 47–72 (explaining many reasons why innovative industries tend to have greater impacts on the economy).

79. *See* MORETTI, *supra* note 40, at 72.

80. BRYNJOLFSSON & MCAFEE, *supra* note 38, at 39–40.

81. *Id*. at 39.

82. *Id.* at 40; *see also* MORETTI, *supra* note 40, at 72 ("The supply of skilled and creative workers capable of innovating is increasing worldwide, as a growing number of young people in emerging economies obtain college and postgraduate education. But the demand for skilled and creative workers is rising even faster.").

83. BRYNJOLFSSON & MCAFEE, *supra* note 38, at 40.

84. MORETTI, *supra* note 40, at 88–97.

85. *Id*. at 93, 94–95; *see infra* Section II.D (discussing these brain hubs in more detail).

the surrounding economy.[86] When innovation industries become established in a location, this increases economic activity, employment, and even salaries for those who provide (non-innovative) local services like restaurants, barber shops, and retail.[87]

Moretti argues this multiplier effect is stronger in the innovation sector, mainly because workers in the innovation sector have more disposable income to spend on local services and more money to spend on construction and real estate.[88] In addition, he argues that high-skilled workers *spread knowledge and skills* to others in the area, increasing their earning power. Somewhat amazingly, Moretti shows that in places where high-skilled workers reside, there is a positive correlation between the number of skilled workers in the city and the salary of their *unskilled* neighbors.[89] Specifically, "the earnings of a worker with a high school education rise by about 7 percent as the share of college graduates in his city increases by 10 percent."[90] Moretti hypothesizes that skills that pass from workers operating in close proximity to one another—a phenomenon he calls "human capital externalities."[91]

The upshot is that the economic gains from innovation for the overall regional economy are extensive, and they are greater than in non-innovation sectors like traditional manufacturing.[92] For these reasons, Moretti concludes, "More than any other sector, innovation has the power to reshape the economic fates of entire communities, as well as their cultures, urban

86. MORETTI, *supra* note 40, at 13, 55–63 (discussing research suggesting that attracting scientists, software engineers, and other high-skill workers to a region increase demand for local services such as restaurants, hairdressers, therapists, and yoga instructors).

87. MORETTI, *supra* note 40, at 55–63, 97–101; *see also* Enrico Moretti & Daniel Wilson, *State Incentives for Innovation, Star Scientists and Jobs: Evidence from Biotech*, NAT'L BUREAU OF ECON. RESEARCH, Working Paper No. 19294 (Aug. 2013), available at http://www.nber.org/papers/w19294.pdf, at 4–5 (finding that state R&D tax incentives and biotech subsidies for local firms were correlated with gains in employment in the non-traded sector, including retail, construction and real estate, suggesting that "by increasing employment in biotech, the incentives indirectly increase employment in local services, like construction and retail, whose demand reflect the strength of the local economy").

88. MORETTI, *supra* note 40, at 61–62 (explaining why the "high-tech multiplier effect" is so much larger than that of other industries).

89. MORETTI, *supra* note 40, at 97–99.

90. *Id*. at 98.

91. *Id*. at 99; *see also* Enrico Moretti, *Human Capital Externalities in Cities*, *in* HANDBOOK OF REGIONAL AND URBAN ECONOMICS (J. Vernon Henderson & Jacques F. Thisse eds., 2004).

92. MORETTI, *supra* note 40, at 55–63, 97–101.

form, local amenities, and political attitudes."[93] As Part V will discuss further, this is precisely why state and local governments are so eager to grow and attract *innovation* clusters in U.S. regions—not, say, clusters devoted to paper making.[94]

### D. WHERE ARE THE INNOVATION CLUSTERS TODAY?

The final question to ask is where precisely these lucky innovation clusters are located. Some places, like Silicon Valley and Boston's Route 128, have become so strongly associated with innovation in the popular imagination that further inquiry seems unnecessary.[95] But how do we identify the others, and what metric do we use to distinguish an innovation cluster from any other region?

There are various ways to observe more precisely where the innovation clusters are today.[96] Patent counts and patents per capita is the most obvious indicator because they tell us where the innovators are probably located.[97] The five states that generate the most patents are California, New York, Texas, Washington, and Massachusetts.[98] The top four states (California, New York, Texas, and Washington) generate almost half of the patents granted in the United States.[99] A similarly striking disparity in patent counts is seen at the level of metropolitan regions. As of 2013, around 63% of U.S.

93. MORETTI, *supra* note 40, at 77.

94. *See, e.g.*, Muro & Katz, *supra* note 41, at 4 (noting that federal and state and local policymakers are embracing the idea that "regional innovation clusters" have the power to re-shape an economy).

95. "[T]hroughout human history we have observed that creative activity has been concentrated in certain places and at certain times; consider Florence under the Medici, Paris in the 1920s, England during the Industrial Revolution, Silicon Valley and even Wall Street in more recent times. For every generation," Feldman and Dieter Kogler write, "there is some location that captures the imagination as a locus of creative activity and energy." Feldman & Kogler, *supra* note 55, at 384.

96. Various metrics are used to measure innovation, including IP ownership. *See* GREENHALGH & ROGERS, *supra* note 7, at 62–63. Other metrics include start-up activity, early-stage venture capital, and employment in high-tech services. *Id*. at 63.

97. MORETTI, *supra* note 40, at 82. As indicators of innovation, patents are imperfect, mainly because patents are both over and under inclusive. Many innovations are not patented, and any patented inventions are never transformed into successful innovations. *See, e.g., id.* at 83 n.1.

98. For patent counts by state for 2015, see PATENT COUNTS BY ORIGIN AND TYPE CALENDAR YEAR 2015, USPTO, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/st_co_15.htm.

99. MORETTI, *supra* note 40, at 83.

patents were developed by people living in just twenty metropolitan areas, home to only 34% of the U.S. population.[100]

Another way to observe where innovation occurs, or is likely to occur, is to observe where people with a college degree are located. Here too, there is significant geographic disparity. Metro areas with the highest share of workers with a college degree include Stamford CT, Washington, DC, Boston, MA, Madison, WI, San Jose, CA, Ann Arbor, MI, Raleigh-Durham, NC, and San Francisco-Oakland, CA. Regions with the lowest share of college-educated workers include Merced, CA, Yuma, AZ, Flint, MI, and Houma-Thibodaux, LA.[101]

Assuming a strong correlation between patents and/or education and value-adding innovation, then these regions should be expected to experience significantly more of the economic benefits of innovation than other regions, even within the same country. The broader point is that innovation, while it obviously benefits society at large, *does not* benefit all geographic communities equally. People living in the innovation clusters above are likely to experience far more of the benefits—higher salaries, better public services, and generally higher standards of living—than people living outside the clusters. The implications of this reality are obviously tremendous. The remainder of this Article discusses the implications for innovation policy, and particularly for public financing of innovation.

## III. INTELLECTUAL PROPERTY AND INNOVATION FINANCE

The subject of this Article, again, is how the geographic distribution of the benefits of innovation impacts innovation policy. What is innovation policy? As noted in the Introduction, scholars identify various mechanisms

100. *See* Jonathan Rothwell et al., *Patenting Prosperity: Invention and Economic Performance in the United States and its Metropolitan Areas*, BROOKINGS INST. (Feb. 2013), at 12–13, https://www.brookings.edu/research/patenting-prosperity-invention-and-economic-performance-in-the-united-states-and-its-metropolitan-areas/. Top patent per capita metro regions include the San Jose-Sunnyvale-Santa Clara, CA (the leader by far), San Francisco-Oakland-Fremont, CA, New York-Northern New Jersey-Long Island, NY-NJ-PA, Los Angeles-Long Beach-Santa Ana, CA, Boston-Cambridge-Quincy, San Diego-Carlsbad-San Marcos, CA, and Seattle-Tacoma-Bellevue, WA. For patent counts at the level of metropolitan area for 2013, see PATENTING IN TECHNOLOGY CLASSES, BREAKOUT BY ORIGIN, U.S. METROPOLITAN AND MICROPOLITAN AREAS, USPTO, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cls_cbsa/allcbsa_gd.htm. *See also* MORETTI, *supra* note 40, at 83–85.

101. MORETTI, *supra* note 40, at 94–95.

through which government can influence innovation.[102] This Article restricts itself to the two major forms of innovation incentive: innovation finance and intellectual property. This section lays out the purpose and operation of each form of incentive, and the most commonly discussed costs and benefits of each. Part IV then discusses how geography influences which level of government should be responsible for which type of incentive.

### A. GOVERNMENT INCENTIVES FOR INNOVATION, GENERALLY

As explained in the last section, innovation benefits society in many ways. But the common wisdom is that, absent incentives, people and firms will under-invest in research, invention and commercialization primarily as a result of the difficulty of appropriating the full value of their productions.[103] The basic problem is that "an innovation can benefit more people and companies than just the innovating firm," and the inability to internalize the full benefits of an innovation "may lead to an undersupply."[104] There are two common theoretical frameworks used to conceptualize this market failure.[105] The first is that the knowledge generated through innovation is a "public good": nonrival and nonexcludable and thus likely to be undersupplied by the private sector.[106] However, although this may be true for a mathematical theorem or basic research performed in a public institution with no near-term application, it is often inaccurate to say that knowledge is nonrival and nonexcludable, especially with respect to applied knowledge in a highly competitive setting where various exclusion mechanisms are possible.[107]

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102. *See* SCOTCHMER, *supra* note 6, at 242–43.

103. *See, e.g.*, GREENHALGH & ROGERS, *supra* note 7, at 17–23 (explaining various market failure in the production of innovation, including public goods, externalities, imperfections in capital markets, and unproductive racing).

104. *Id*. at 17–18.

105. "Market failure" is used to describe a situation where there is a strong possibility that the market, guided only by the actions of private actors, will not lead to the optimal outcome. *See* GREENHALGH & ROGERS, *supra* note 7, at 18.

106. The basic definition of a public good is that it is nonrival (one person's consumption of it does not interfere with another's) and nonexcludable (others cannot efficiently be excluded from using the public good). MANKIW, *supra* note 37, at 218–21 (discussing typical kinds of public goods and explaining the "free-rider" problems associated with public goods). For IP scholarship using the public good justification see, for example, Wagner, *supra* note 32, at 1005–07.

107. Several sources note the ways in which knowledge in the commercial world does not behave as a public good at all. GREENHALGH & ROGERS, *supra* note 7, at 18–20. Once applied in a commercial product, knowledge can be quite rivalrous: imitation by a competitor, even though it does not deplete the value of the knowledge itself, depletes the

The second framework, which is superior for discussions of most commercial innovations, is that innovation creates positive externalities (or spillovers) for others that are not taken into account in private investment decisions.[108] The purpose of intellectual property regimes like patents is said to be "to correct this externality by more closely aligning the private and social value of producing new information."[109] By giving inventors the chance to patent their inventions, patents increase incentives to invest in research and invention, and thereby indirectly increase their incentives to commercialize patented ideas.[110]

But intellectual property rights are not the only incentive government can use to spur investment in innovation. Governments also use innovation finance: public financing for innovation drawn from public revenues.[111] Innovation finance has the same general purpose as IP—to fund innovation in light of market failure and correct for the externalities associated with innovation—except rather than creating property rights, government uses public money to make up the difference between the social returns and the private returns from innovation.[112] Examples of innovation finance include research grants, prizes, tax credits, public venture capital, investments in education and working training, and other direct expenditures of public money on the innovation enterprise.[113]

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profits of the first producer of the knowledge. *Id*. at 19. Many kinds of knowledge can be excluded even absent IP protection (e.g. through secrecy). *Id.* at 19–20; *see also* Tim Wu, *Properties of Information & the Legal Implications of Same*, COLUMBIA CTR. FOR L. AND ECON. STUDIES, Working Paper No. 482 (June 2014) (discussing recent literature noting the limits to information's status as a public good).

108. GREENHALGH & ROGERS, *supra* note 7, at 20; *see also* Duffy, *supra* note 20, at 693 (noting that the patent system attempts to "account for the positive externalities associated with the creation of technical information").

109. Duffy, *supra* note 20, at 694.

110. *See, e.g.*, *id*. at 693–94.

111. *See, e.g.*, SCOTCHMER, *supra* note 6, at 242–43.

112. SCOTCHMER, *supra* note 6, at 242–43; GREENHALGH & ROGERS, *supra* note 7, at 24–25.

113. The literature on non-IP incentives to invest in innovation is vast and growing. *See, e.g.,* Frischmann, *supra* note 5, at 377–92 (discussing different forms of incentives including tax, research grants, and procurement); SCOTCHMER, *supra* note 6, at 40–46 (discussing innovation prizes); Hemel & Ouellette, *supra* note 5, at 303 (discussing prizes, grants, and R&D tax credits); Hrdy, *Commercialization Awards*, *supra* note 5, at 51–72 (discussing state and federal venture capital programs); *see also* JAMES BESSEN, LEARNING BY DOING: THE REAL CONNECTION BETWEEN INNOVATION, WAGES, AND WEALTH 19–20 (2015) (discussing the need for investment in education and other incentives for encouraging "broad based learning of new technical skills").

## B. MAJOR DIFFERENCES BETWEEN INTELLECTUAL PROPERTY AND INNOVATION FINANCE

The major distinctions between IP and innovation finance have been discussed by economists who study innovation such as Suzanne Scotchmer,[114] and drawn out recently by IP scholars like Amy Kapzcynski and Lisa Larrimore Ouellette.[115] There are two dimensions to these discussions: efficiency and fairness.

### *1. Efficiency*

From the perspective of efficiency, the fundamental difference between IP and innovation finance is that IP does not involve an expenditure of public funds; IP relies on innovators and private markets to determine the technical and commercial value of an innovation. As Scotchmer put it, the "lure of intellectual property" as opposed to "public sponsorship" of innovation is that IP automatically "tap[s] ideas for invention that are widely distributed among firms and inventors."[116] Government does not have to tell people what or whether to innovate; it just creates the possibility of obtaining an IP right for a qualifying innovation.[117]

On the other hand, IP rights create deadweight loss in the sense that some people cannot afford to pay for IP-protected goods who otherwise could.[118] This deadweight loss is the "static," short-term inefficiency of IP: where consumers cannot buy what they otherwise could in an unaltered market.[119] IP also creates "dynamic," longer term inefficiencies because consumers of the innovation may themselves be innovators, and the existence of IP rights may prevent them from researching or marketing cumulative innovations that otherwise would have benefited society.[120]

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114. *See* SCOTCHMER, *supra* note 6, at 37–40.

115. Kapczynski, *supra* note 5, at 970–80; Hemel & Ouellette, *supra* note 5, at 303; *see also* Frischmann, *supra* note 5, at 348–92.

116. SCOTCHMER, *supra* note 6, at 38.

117. *Id.*; *see also* Hemel & Oullette, *supra* note 5, at 303 (observing that patents are "market-set").

118. As Kapczynski explains, "Because information should ideally be priced at zero, any positive price generates static (short term) inefficiency, which economists refer to as deadweight loss. This kind of net loss of social welfare 'occurs when people are excluded from using the good even though their willingnesses to pay are higher than the marginal cost.'" Kapczynski, *supra* note 5, at 982 (quoting SCOTCHMER, *supra* note 6, at 36).

119. *Id.*

120. *Id.* ("Positive price compromises not only static but also dynamic efficiency because information is an input and output of its own production process."); *see also* Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSPECTIVES 29, 32–35 (1991) (asserting that patent incentives for initial creators can impede cumulative innovation by second-generation creators).

Another problem, also highlighted in Kapczynski's work, is that IP rights, and patents in particular, can distort investment in innovation at a structural level by awarding some forms of innovation but not others or by awarding some forms of innovation more than others.[121] For example, patents have a limited term length and so may be less valuable for innovations that take a long time to test and develop; patents cannot be obtained for publicly disclosed innovations[122] and do not provide an incentive to innovate when the exclusive right is virtually impossible to enforce; and patents serve little purpose when there is no private market at all absent government procurement.[123] The risk of distortion of innovation, along with the usual concern about deadweight loss, has led scholars like Kapczynski to be skeptical that exclusive rights, on their own, will ensure efficient production of new information.[124]

In contrast, innovation finance avoids the static and dynamic inefficiencies of creating exclusive rights; applies to a broader variety of innovations, including those that are best kept secret or otherwise hard to protect through IP; and addresses multiple market failures, including where innovators have trouble raising money to finance their operations.[125] Perhaps most importantly, because innovation finance is not dependent on

121. *See* Kapczynski & Syed, *The Continuum of Excludability and the Limits of Patents*, 122 YALE L.J. 1900, 1942 (2013) (concluding "that a patent system will predictably and systematically distort private investment decisions regarding innovation, overstating the value of highly excludable information goods and understating the value of highly nonexcludable ones," and thus "fail to provide sufficient private returns to enable investment in certain information goods that clearly offer a net social benefit"). For a detailed discussion of the problem of patent-caused distortion of innovation in the pharmaceutical industry, see Sachs, *supra* note 8, at 8–19.

122. For example, some argue that drug companies lack sufficient incentives to innovate in manufacturing methods in part because they must rely mainly on secrecy to protect these methods. Nicholson Price, *Making Do in Making Drugs: Innovation Policy and Pharmaceutical Manufacturing*, 55 B.C. L. REV. 491, 523 (2014) (arguing that "the unique aspects of trade secrecy—including its practical limitations, an unbounded timeframe, process specificity, and limitations on personnel—make it structurally less capable of incentivizing pharmaceutical innovation").

123. *See* Sachs, *supra* note 8, at 8–19 (identifying and discussing three forms of patent-caused distortion in the pharmaceutical industry); *see also* Camilla A. Hrdy, *Rachel Sachs: Prizing Insurance*, WRITTEN DESCRIPTION (May 31, 2016), http://writtendescription.blogspot.com/2016/05/rachel-sachs-prizing-insurance.html.

124. *See* Kapczynski & Syed, *supra* note 121, at 1960 ("If, as we have shown, property rights in information are themselves potentially distorting, then even if our sole aim is to achieve efficiency, we cannot assign decisions about allocation solely to the market.").

125. For example, while patents address the appropriability problem, they do not directly address credit constraints in commercialization. Public financing for new companies may be superior to commercialization patents in this respect. *See* Hrdy, *Commercialization Awards, supra* note 5, at 43–51.

signals from the market, it can accomplish something IP cannot: promote innovations with broad social consequences that are not necessarily profitable enough to be attractive under an IP-only regime. In this regard, scholars have explored many options besides just grants and prizes. For example, Peter Lee explains in a recent article that IP rights are especially ineffective at promoting "social innovations" in areas like health, safety, education, and environmental protection. Instead, social innovations rely largely on non-market mechanisms such as government funding and charitable markets.[126]

These strengths have to be weighed against the fact that innovation finance requires some level of government involvement to determine how much the innovation is worth and how much public money government should spend on its success. Daniel Hemel and Lisa Larrimore Ouellette thus refer to innovation finance mechanisms such as grants and prizes as "government-set" rather than "market-set" rewards for innovation: they rely on public officials rather than decentralized markets and the forces of supply and demand to figure out how much a particular technology should be subsidized.[127] When the government has more information than the private sector, then government has an easier time making this determination.[128] But when the government does not have more information than the private sector, this necessarily requires public officials at some level "to figure out how much a particular technology should be subsidized" without the guidepost of supply and demand.[129] Commentators have proposed various ways that government could link government rewards with market returns. For instance, before funding research, government could require innovators to obtain matching funds from private investors to mitigate the risks associated with choosing between different projects or different avenues or research.[130] But the mechanisms are by no means perfect. Thus, just like

126. *See* Lee, *supra* note 5, at 1–10. More recently, Rachel Sachs has argued that prescription drug insurance could be turned into a non-market mechanism for promoting pharmaceutical innovation. *See* Sachs, *supra* note 8, at 34–41 (arguing that prescription drug insurance could be wielded as an innovation incentive in a way that addresses the "market-shaped innovation distortions" of patent law).

127. Hemel & Ouellette, *supra* note 5, at 327. Hemel and Ouellette's insight is that some forms of innovation finance, such as R&D tax credits, are more dependent on market signals than others.

128. Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 83 AM. ECON. REV. 691, 691–92 (1983).

129. Hemel & Ouellette, *supra* note 5, at 327.

130. *See* Hrdy, *Commercialization Awards*, *supra* note 5, at 14, 58–59 ("In order to mitigate the risks associated with government 'picking winners,' awards require obtaining private sector matching before money changes hands.").

with IP, innovation finance is likely to result in some deadweight loss, including wasted public money on bad investments and distortion of innovation decisions in the private sector.[131]

*2. Fairness*

According to Scotchmer, IP is also likely to be fairer in many cases because innovations that are covered by IP rights are ultimately financed directly by users of the innovation rather than general taxpayers.[132] As she put it, with IP, "[e]ach innovation is paid for voluntarily through proprietary prices."[133] In contrast, innovation finance mechanisms like procurement and prizes will often draw on general taxpayer revenues to finance innovations that benefit some taxpayers but not others. While public funding for technologies that help entire populations, such as vaccines for common diseases, may be uncontroversial, in many situations, "different constituencies" may "argue for different R&D projects."[134] For instance, many would probably prefer users of discretionary consumer products like music players to subsidize the research that supplies those products, rather than everyone who pays taxes.[135] As Scotchmer put it, "[t]axpayers might rightfully revolt if asked to bear the costs of developing, say, computer games."[136] In other words, with IP, people agree to pay more for what they want rather than being forced to pay for what they do not want through the tax system.

However, IP rights create other fairness issues. As Kapczynski has pointed out, IP rights can challenge the principles of distributive justice, which is concerned with the allocation of resources across society.[137] Because IP rights tend to force consumers to pay more for products than they otherwise would in a naked market, the gains from IP-protected goods

131. Deadweight loss in this context is the fall in total welfare due to people allocating resources according to the incentive rather than the true costs and benefits of the innovation. MANKIW, *supra* note 37, at 159, 242; *see also* Kapczynski, *supra* note 5, at 980–81.

132. SCOTCHMER, *supra* note 6, at 38–39. For the argument that the "user pays" feature of IP comports with distributive justice, see Jeremy Sheff, "Who Should Pay for Progress? – IPSC Draft Talk" (Aug. 6, 2014), http://jeremysheff.com/2014/08/06/who-should-pay-for-progress-ipsc-talk-draft/.

133. SCOTCHMER, *supra* note 6, at 38; *see also* Hemel & Ouellette, *supra* note 5, at 346.

134. SCOTCHMER, *supra* note 6, at 39.

135. *See id*. at 38.

136. *See* Nancy Gallini & Suzanne Scotchmer, *Intellectual Property: When Is It the Best Incentive System?*, 2 INNOVATION POL'Y & ECON. 51, 55 (2002).

137. Kapczynski, *supra* note 5, at 995.

such as expensive pharmaceutical drugs are often unevenly distributed across society, limited to those people who can pay for access.[138] In theory, innovation finance can be used to mitigate this problem or to deliberately redistribute resources from one segment of the population to another. For example, if government directly finances research into diseases that are more frequently found in poorer populations, this could constitute a redistribution of resources from the wealthy to the poor.[139] On the other hand, some argue that IP rights themselves have a redistributive component. For example, Madhavi Sunder has argued that the expansion of global IP protections can serve as "a tool for protecting poor people's knowledge" in undeveloped countries even as it protects the "knowledge and economic interests of the developed world."[140]

## IV. THE ROLE OF JURISDICTION IN INNOVATION POLICY CHOICES

The upshot of the last section is that there are two ways to promote innovation and yet no principled way to choose between them. Both have costs and benefits, and in some cases they perform different functions. A previously unobserved dimension in this debate is the role of jurisdictional allocation in innovation policy choices. If optimizing efficiency in innovation policy is a goal, a good place to start is to consider which jurisdiction should be responsible for innovation policy and, more specifically, for *which aspects* of innovation policy. This section argues that, within the United States, which jurisdiction is responsible—national or subnational—depends in part on which policy tool is selected—intellectual property rights or innovation finance. In turn, which policy mechanism we choose may influence which jurisdiction is responsible. This section will show that if patents are selected, jurisdiction is more likely to be national or even global. If innovation finance is selected, however, jurisdiction should often be local.

138. *See id.* at 993–96.

139. *See* MADHAVI SUNDER, FROM GOODS TO THE GOOD LIFE 174–78 (2012) (discussing the downsides of patents in supplying life-saving drugs to the poor, including pricing out poor consumers and insufficient research into "neglected diseases" that mainly afflict poor populations); *see also* Kapczynski, *supra* note 5, at 1001–02 (arguing that government procurement including prizes and contracts are promising alternatives to IP in distributive terms and might be used to facilitate access for the poor).

140. *See, e.g.*, SUNDER, *supra* note 139, at 126–44 (arguing that IP rights such as patents, copyrights, and geographic indicators can provide a tool for protecting the knowledge and cultural heritage of poor people in less developed economies).

### A. COLLECTIVE ACTION FEDERALISM

In addressing the question of jurisdictional allocation, this section relies on the collective action theory of federalism, which appears in Cooter and Siegel's oft-cited article, *Collective Action Federalism: A General Theory of Article 1, Section 8.*[141] The basic rule is that the scope of national authority depends on whether there is a "collective action failure" that prevents states from resolving the problem in an efficient manner on their own. Whether a collective action failure exists depends on whether state action would produce severe inter-jurisdictional externalities (spillovers) that prevent effective resolution of the public problem and that states cannot resolve through inter-state negotiations because the transaction costs are very high.[142] Otherwise, when no collective action failure exists, we should follow the "internalization principle": assign power to the smallest subnational government that internalizes the benefits of its policies without creating spillovers for other regions.[143]

This theory is not new but is derived from longstanding literature on economic federalism.[144] Cooter and Siegel's innovation is to simplify the framework into two basic concepts—collective action failure and the internalization principle—and to argue that these concepts explain and justify the basic structural framework of the U.S. Constitution, in which the states possess all powers they had prior to ratification of the Constitution unless those powers are divested, expressly or implicitly, by the national powers specifically enumerated in Article I, Section 8.[145] So while this

141. Cooter & Siegel, *supra* note 14, at 118–119; *see also* Neil Siegel, *Collective Action Federalism and its Discontents*, 91 TEX. L. REV. 1937 (2013).

142. Cooter & Siegel, *supra* note 14, at 118–19, 139–40 (explaining the relevance of transaction costs for their theory).

143. *Id.* at 137.

144. For examples of scholarship discussing common economic theories of federalism (often called simply "economic federalism"), see Robert P. Inman & Daniel L. Rubinfeld, *Rethinking Federalism*, 11 J. ECON. PERPS. 43, 45 (1997) ("The principle of economic federalism prefers the most decentralized structure of government capable of internalizing all economic externalities, subject to the constitutional constraint that all central government policies be decided by an elected or appointed 'central planner.'"); Wallace E. Oates, *An Essay on Fiscal Federalism,* 37 J. ECON. LIT. 1120, 1122 (1999) (stating that the "basic principle of fiscal decentralization" is "the presumption that the provision of public services should be located at the lowest level of government encompassing, in a spatial sense, the relevant benefits and costs"). *See also* Richard A. Posner, *Toward an Economic Theory of Federal Jurisdiction*, 6 HARV. J.L. & PUB. POL'Y 41, 41–50 (1982) (applying economic federalism to address the optimal allocation of authority between federal and state courts).

145. *See* Cooter & Siegel, *supra* note 14, at 118–119; U.S. CONST. art. I, § 8, amend. X. Jack Balkin provides a similar justification for the national government's authority to

Article uses Cooter and Siegel's terminology, it actually relies on the body of economic federalism theory itself.

Economic federalism theory typically seeks to determine the optimal, most efficiency-enhancing allocation of authority between federal and state governments with respect to substantive areas of law.[146] But it has also been adopted, for example, to decide whether jurisdiction should be assigned to federal or state courts.[147] In that context, Richard Posner explains economic federalism in very similar terms to Cooter and Siegel, writing that the economic theory of federalism contains "a presumption in favor of shifting governmental power from higher to lower levels, from broader to narrower jurisdictions—for present purposes, from the federal to the state level."[148] (This is the internalization principle prescribing local jurisdiction.) However, "If either the benefits or the costs of a governmental action are felt outside the jurisdiction where the action is taken, and the costs of negotiations between governments are assumed . . . to be very high, then there is a strong argument that the responsibility for the action should be assigned to a higher level of government with a broader jurisdiction.[149] (This is the collection action failure necessitating federal jurisdiction.)

The economic federalism framework also closely resembles the "principle of subsidiarity" underlying the relationship between the European Union and its member states. "Under the principle of subsidiarity," the European Union Treaty states, "in areas which do not fall within its exclusive competence, the Union shall act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at Union level."[150]

The economic federalism framework has often been applied specifically to the financing of public goods. Here, economic federalism prescribes that the national government should be responsible for "national public goods"

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regulate commerce under Article I, Section 8, Cl. 3. *See* JACK M. BALKIN, LIVING ORIGINALISM 140 (2011) ("Properly understood, the commerce power authorizes Congress to regulate problems or activities that produce spillover effects between states or generate collective action problems that concern more than one state.").

146. *See, e.g.*, Inman & Rubinfeld, *supra* note 144; Oates, *supra* note 144.

147. Posner, *supra* note 144, at 41 ("The specific question I want to address today is how economics, and specifically the economic theory of federalism, can aid decisions with respect to [the] allocation [of responsibilities between state and federal courts.]").

148. *Id*. at 45.

149. *Id*. at 45.

150. Consolidated Treaty on European Union art. 5, Dec. 13, 2007, 2012 O.J. (C 326) 1. Thank you to Jean Galbraith and Lee Anne Fennell for this point.

that implicate inter-jurisdictional spillovers, such as national security.[151] In contrast, state and local governments should be responsible for "local public goods" that are associated with a physical location and mainly affect a local population. Typical examples of local public goods include parks and fire stations.[152] Unlike national public goods, which are said to be "pure" public goods because they are characterized by a high degree of nonrivalry and nonexcludability, local public goods are not necessarily nonexcludable or even nonrival. At some point, local public goods may suffer from congestion (crowding), meaning that one person's enjoyment of the good detracts from others' enjoyment.[153]

### B. APPLICATION TO INNOVATION POLICY

We can now apply economic federalism theory to determine which level of government should be responsible for which aspect of innovation policy. The simple question to ask is: what is the smallest level of government that internalizes the benefits of an IP regime, on the one hand, and innovation finance on the other?

When it comes to IP rights like patents, national jurisdiction is generally required.[154] In most cases, IP creates too many spillovers—cross-border copying of inventions and creative productions—for states to protect on their own. Subnational governments like states have a difficult time appropriating the benefits of new knowledge generated in innovation through patent rights. The reason is that patents, like real property rights, operate through the mechanism of exclusion, and are only valuable to the extent that they *actually prevent others from using the protected subject matter in the relevant market.*[155] Once the actual or potential market for an

151. *See* COOTER, *supra* note 14, at 105–07; Cooter & Siegel, *supra* note 14, at 137–38. For a fuller explanation of the difference between national and local public goods and different mechanisms for supplying them, see DENNIS MUELLER, CONSTITUTIONAL DEMOCRACY 81–83 (1996) (discussing public goods at the local, city, regional, national, and global level); JOSEPH STIGLITZ, ECONOMICS OF THE PUBLIC SECTOR 733–34 (3d ed. 2000) (using examples to illustrate the difference between local public goods and national public goods).

152. *See* COOTER, *supra* note 14, at 106; Cooter & Siegel, *supra* note 14, at 137.

153. *See* COOTER, *supra* note 14, at 105–07; Cooter & Siegel, *supra* note 14, at 137–38.

154. *See* Cooter & Siegel, *supra* note 16, at 149 ("Because the problem of unauthorized use extends across state lines, the problem is national and Congress is better placed than the states to solve it.").

155. As noted above, IP scholars disagree over the *degree* to which innovators must internalize the benefits of their innovations, but, in the common utilitarian framework, the accepted role of IP is to assist creators in internalizing the benefits of their innovations by giving them reasonably effective rights of exclusion. *Compare, e.g.,* Wagner, *supra* note 32, at 1033 (arguing that strong intellectual property rights in information "expands the

invention become interstate, state patent laws with limited jurisdictional reach simply cannot perform this function without risking out-of-state copying of their inventors' patented inventions.[156] Thus, if we choose patents as the innovation incentive, we are also necessarily choosing national, and probably eventually global, jurisdiction.[157]

However, local governments *can* appropriate at least some of the benefits of innovation using innovation finance. Innovation finance incentives, such as research grants, prizes, and tax credits, do not operate through the mechanism of exclusion. Thus, the threat of instantaneous cross-border competition does not make them inherently ineffectual.[158] Moreover, as discussed in detail in Part II, the immediate economic impacts of innovation tend to be geographically localized and concentrated in certain parts of the country. Although innovation produces various national benefits—including consumer surplus, long-term improvements in economic well-being, and knowledge spillovers with respect to information that is easy to transfer and that has widespread relevance in interstate markets—innovation also produces significant "internalities" for the jurisdictions in which innovation occurs, including high-paying employment, increased business activity, and increased tax revenues.[159] In theory, local governments can, through the mechanism of public finance, capture enough of these benefits to give them an incentive to finance innovation.[160]

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total sum of open information available for further technological, cultural, and social development"), *with* Frischmann & Lemley, *supra* note 32, at 258 (asserting that *complete* internalization of externalities is not necessary to optimize IP-based incentives to innovate).

156. *See, e.g.*, Hrdy, *State Patents as a Solution*, *supra* note 20, at 111 (observing that states cannot internalize all the benefits of the research and information produced by state patents); *see also* Hrdy, *State Patent Laws in the Age of Laissez Faire*, *supra* note 25, at 67–70 (on the end of U.S. state patent laws in the wake of interstate commerce).

157. As John Duffy has observed, externalities—the risk of cross-border copying and the flow of knowledge from one nation to another—is the primary justification for globally harmonized patent systems as well. *See* Duffy, *supra* note 20, at 693–700, 707–09.

158. Take a simple example. A state patent for an invention sold in interstate commerce is valueless or nearly valueless, assuming out-of-state competitors can quickly copy the invention and freely reproduce it. But the value of a state subsidy for the same invention, such as a prize or a research grant, is not valueless. It can provide an incentive to research the invention ex ante or compensate the inventor for her labor after the fact.

159. This Article borrows the term "internality" from Professor Cooter. *See* COOTER, *supra* note 14, at 109; *see also supra* Section II.C.

160. As in the case of IP rights, one can argue over the degree to which states must internalize the benefits to adopt policies that support local innovation. This issue is discussed further *infra* Section IV.C.3.

Therefore, if one takes seriously the internalization principle and the economic federalism literature from which it is derived, state and local governments should sometimes be responsible for financing innovation as a local public good. If one chooses innovation finance as the innovation incentive, one may also necessarily be choosing a local jurisdiction.

### C. THE BENEFITS OF LOCAL JURISDICTION IN INNOVATION FINANCE

There are various advantages to choosing local rather than national jurisdiction in innovation finance. Proponents of economic federalism give various efficiency-based justifications for adopting a baseline preference for localism in the absence of significant externalities. Richard Schragger identifies three common justifications: local governments' stronger incentives to pursue policies that provide for a healthy local economy; the efficiency-promoting effects of inter-jurisdictional competition for mobile residents; and the greater propensity of state and local governments to take risks and adopt "policy experiments."[161] Without taking a stand on whether these views are correct, this Article briefly explains each below and how it may apply in the context of innovation finance.

#### *1. Better Incentives to Design Effective Local Innovation Policies*

The main efficiency-based justification that Cooter and Siegel provide for preferring a local jurisdiction in the absence of severe spillovers is that local officials are likely to have better incentives to supply, and design policies relating to, local public goods in a manner that meets residents' needs and preferences.[162] Specifically, Cooter and Siegel argue that residents "possess better information than nonresidents" when it comes to situating and scaling local public goods, and "stronger incentives than nonresidents to monitor the officials responsible for creating and maintaining" those goods; in turn, local officials have "better incentives than central officials" to supply the goods in response to residents' demands.[163]

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161. *See* Richard C. Schragger, *Decentralization and Development*, 96 VA. L. REV. 1837, 1853–63 (2010); *see also, e.g.,* Jonathan Adler, *Interstate Competition and the Race to the Top*, 35 HARV. J.L. & PUB. POL'Y 91–92 (2013) (discussing the economic benefits of inter-jurisdictional competition); John C. Yoo, *The Judicial Safeguards of Federalism*, 70 S. CALIF. L. REV. 1311, 1402–03 (1997) (citing literature on economic federalism to justify preserving federalism).

162. Cooter & Siegel, *supra* note 14, at 137–38 (explaining the claim that local officials should have better incentives than central officials with respect to supplying many local public goods); *see also* COOTER, *supra* note 14, at 106.

163. Cooter & Siegel, *supra* note 14, at 138; *see also* COOTER, *supra* note 14, at 106.

An unstated assumption of Cooter and Siegel's theory is that local officials must seek to satisfy the needs of local residents because otherwise residents will object and/or leave the jurisdiction.[164] On this view, local governments are motivated largely by the threat of flight to other U.S. (or foreign) jurisdictions. In this sense, Cooter and Siegel's theory resembles a slightly distinct theory of federalism, called "market-preserving federalism," popularized by Barry Weingast.[165] On this view, "inter-jurisdictional competition provides political officials with strong fiscal incentives to pursue policies that provide for a healthy local economy."[166] More specifically, Weingast explains, "As long as capital and labor are mobile, market-preserving federalism constrains the lower units in their attempts to place political limits on economic activity, because resources will move to other jurisdictions."[167]

The main implication of these views for innovation policy are that subnational governments should have exceptionally strong incentives to take actions that foster innovation at the regional level to the extent that the economic impacts of innovation are concentrated in the region and do not spill over significantly to other states.[168] Local governments certainly attempt to foster regional innovation economies in practice. States typically have economic development offices whose primary responsibility to is to design innovation incentives that will promote economic development, and

164. Note that the "threat of flight" is not necessary for Cooter and Siegel's view to hold. As Schragger notes, "The threat of exit need not be the only mechanism [motivating governments]; presumably electoral pressure will induce officials to act one way or another." Schragger, *supra* note 161, at 1854. That said, the notion that local officials are motivated by the threat of flight to other U.S. jurisdictions certainly strengthens Cooter and Siegel's argument that local officials have stronger incentives than the national government to satisfy resident voters' demands. *See* Cooter & Siegel, *supra* note 14, at 138 ("[L]ocal officials have better incentives than central officials for supplying local public goods.").

165. *See, e.g.*, Barry Weingast, *Second Generation Fiscal Federalism*, 65 J. URB. ECON. 279, 280–82 (2009); *see also* Schragger, *supra* note 161, at 1853–54 (explaining the core tenets and assumptions of market-preserving federalism).

166. *See* Schragger, *supra* note 161, at 1853 (quoting Weingast, *supra* note 165, at 281).

167. Barry Weingast, *The Economic Role of Political Institutions: Market-Preserving Federalism and Economic Development*, 11 J. L. ECON. & ORG. 1, 5 (1995). As Schragger notes, this particular view—that "the cost of capital flight drives officials' behavior"—relies on the assumption that the national government does not experience the same level of inter-jurisdictional competition, presumably because the threat that residents will leave the United States altogether is not as realistic. Schragger, *supra* note 161, at 1853. *But see id*. at 1854–55 (questioning whether local officials really have stronger incentives to provide for a healthy local economy than central government officials).

168. *See* Cooter & Siegel, *supra* note 14, at 138; *see also* COOTER, *supra* note 14, at 106.

to collect information and keep reports about ongoing progress and challenges to economic development in the region.[169] As Part V will discuss, the pervasiveness and variety of local innovation incentives is staggering.

A further implication of Weingast's view that the threat of flight motivates subnational governments is that local innovation policies should be more sensitive than federal innovation policy to the relatively near-term demands of the mobile actors that make up an innovation economy. They should be specifically designed to attract venture capital, research corporations, innovative start-ups, university faculty, highly skilled talent, and all the other mobile ingredients of a cluster.[170] As already alluded to, this holds true in practice. The explicit goal of U.S. state innovation incentives is to spur jobs and business activity *in the region*, potentially at the expense of others. As the next section will discuss, this is quite different from the tenor of federal innovation policy, which is more focused on the production of national public goods (mainly national security) and the production of information whose near-term economic value is not always clear.[171]

### *2. Tiebout Clustering*

A slightly different view is that local jurisdiction should be preferred in the absence of severe spillovers because inter-jurisdictional competition leads to more efficient provisioning of local public goods and efficient sorting of residents into appropriate locations.[172] In an influential article, Charles Tiebout, hypothesized that local governments supply local public goods based on the demands of mobile "consumer voters," who can "shop" among local jurisdictions for the community that best satisfies their preferences; therefore local jurisdictions will provide public goods that meet those preferences as efficiently as possible.[173] The thrust of this argument, as one economist puts it, is that "[c]ompetition among communities . . . will result in communities' supplying the goods and

169. *See, e.g.*, MICHIGAN ECON. DEV. CORP., *Transparency*, http://www.michiganbusiness.org/about-medc/transparency/ (last visited May 4, 2016); TEXAS ECON. DEV. CORP., *Reports, Directories & Databases*, https://texaswideopenforbusiness.com/resources/reports-directories (last visited, May 4, 2016).

170. *See* Weingast, *supra*, note 165, at 281.

171. See discussion *infra* Section V.B.1.

172. *See* Inman & Rubinfeld, supra note 144, at 46 (explicating Tiebout's hypothesis); STIGLITZ, *supra* note 151, at 734–36 (also explicating Tiebout's hypothesis).

173. Charles M. Tiebout, *A Pure Theory of Local Expenditures*, 64 J. POL. ECON. 416, 418–20 (1956).

services individuals want and producing these goods in an efficient manner."[174]

According to Cooter, the major benefit of the Tiebout hypothesis is that "sorting diverse populations into groups with relatively homogenous tastes can give each of [those groups] their preferred public goods."[175] Cooter refers to this as "clustering"—where "[p]eople with similar tastes voluntarily cluster together in order to enjoy their preferred combination of local public goods." For example, if one person values parks more than safe streets, and another values safe streets more than parks, each person can move to the locality that specializes in parks or safe streets, respectively.[176]

Importantly, the Tiebout hypothesis is subject to major limitations, including that people are perfectly mobile and have full knowledge of the differences between possible jurisdictions; and many doubt whether efficient sorting of mobile residents occurs in practice.[177] But nonetheless the Tiebout hypothesis has been used to support the assumption that a "competitive, decentralized system of local government goods provision would be more tailored to local conditions than a centralized one," and that this configuration contributes to economic growth in regions such as the United States with federal constitutional systems and local government autonomy.[178]

Tiebout clustering has obvious application in the context of innovation clusters. According to the theory, mobile residents—venture capital, research corporations, innovative start-ups, university faculty, skilled talent—will sort themselves into innovation clusters based on their shared preferences, and subnational governments will then tailor their programs to meet those preferences in competition with other states. Tiebout's competitive location market should be more favorable to the creation of innovation clusters than a purely centralized policy.[179]

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174. STIGLITZ, *supra* note 151, at 735.

175. COOTER, *supra* note 14, at 129.

176. *Id*.

177. Tiebout made clear that his theory only applied if certain assumptions are made—most importantly, that "consumer-voters are fully mobile and will move to that community where their preference patterns, which are set, are best satisfied." Tiebout, *supra* note 173, at 419; *see also* Schragger, *supra* note 161, at 1857–59 (discussing the major limitations and critiques of the Tiebout hypothesis).

178. Schragger, *supra* note 161, at 1858 (describing and critiquing this assumption); *id*. at 1837 (challenging the thesis that political decentralization in America has promoted economic development).

179. I am hardly the first to make this argument. Maryann P. Feldman, whose empirical work Section V.B.2 discusses, has been making this argument for years. *See, e.g.*, Maryann P. Feldman, *Location, Location, Location: Creating Innovation Clusters*, DEMOCRACY: A

Take the following example. All subnational governments that are interested in creating a certain type of technology cluster—say, electric vehicles—can compete with one another to design policies they believe will work best, crafting tailored incentives and supplying appropriate infrastructure. Meanwhile, other states can specialize in nurturing other technology areas where they see a comparative advantage: solar in Arizona, aviation in Illinois, medical research in Connecticut, and so on. Firms and talent working in these technology areas (Tiebout's "consumer-voters") can "vote with their feet," locating in the places whose goals and policies suit their particular needs. The result would—theoretically—be higher-performing innovation clusters, and more innovation overall.

While it is not *necessary* to believe in the Tiebout hypothesis to support local jurisdiction over innovation policy—because, as mentioned, there are thought to be other benefits from relying on local officials to craft local policy—the Tiebout hypothesis does provide another justification for preferring local government when possible, and may have particular relevance if, as cluster policy advocates contend, innovation really does proceed more efficiently in clusters.[180]

Importantly, as Schragger observes, efficient clustering via the Tiebout model can be obtained without full political decentralization of innovation policy.[181] Rather than requiring each subnational jurisdiction to fund and independently design its own innovation policies, the federal government could provide funding to local governments on a competitive basis and provide guidelines for them to follow in crafting their policies. For example, former Michigan Governor Jennifer Granholm has spoken in favor of a new "Race to the Top" program in which states would compete for federal funds to incubate clean energy innovation in sectors like solar, wind, or electric vehicles.[182] Winners would use the funds to create various clean energy

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JOURNAL OF IDEAS (No. 21, Summer 2011) ("One of the strengths of American federalism is that each level of government has a role to play. In the case of clusters, regional and local agencies are better able than federal entities to tailor programs to the specific needs of local industry.").

180. See discussion of cluster theory in Section II.C.

181. *See* Schragger, *supra* note 161, at 1858. That said, Cooter and Siegel stress the importance of fiscal fairness—the notion that local public goods should be financed using local taxes so that the beneficiaries of local public goods pay for them. Cooter & Siegel, *supra* note 14, at 138 ("[A] local public good can be financed by a local tax, which primarily hits the beneficiaries and misses nonbeneficiaries."). This coincides with the "benefits principle" of taxation: the idea that people should pay taxes based on the benefits they receive from government services. *See* MANKIW, *supra* note 37, at 246.

182. *See* Anthony Flint, *Could We Model a National Energy Policy on 'Race to the Top'?*, THE ATLANTIC: CITY LABS (Feb. 28, 2013), http://www.theatlanticcities.com/

innovation incentives, from tax credits to partnerships with state universities.[183] This competition could be expanded to cover the whole range of technology areas that the federal government thinks are important. As Granholm puts it, "Every state would have something to contribute." California could focus on solar and Midwestern states on wind power, while Michigan could focus on electric car batteries.[184] I discuss this more cooperative approach to innovation policy in a separate article.[185]

*3. Innovation Policy Experiments*

There is "another valid, and even more familiar, argument for preferring state government—the 'experiments in separate laboratories' argument."[186] "Decentralization," Richard Posner writes, is said to provide "valuable information about the provision of public services because diverse polities naturally hit on different solutions to common problems and the results of these different solutions can be compared."[187]

Several scholars, including myself, have pointed out the importance of experimentation in patent law and innovation policy in particular.[188] Lisa Larrimore Ouellette, for instance, has stressed the importance, in the patent law context, of promoting "innovation in promoting innovation."[189] However, this kind of experimentation in innovation policy design will only realistically occur if jurisdictions are *first* able to reap the benefits of their policies. Why would regions bother to innovate if they cannot reap the

politics/2013/02/could-we-model-national-energy-policy-race-top/4829/ (quoting Granholm's TED talk in Long Beach, CA).

183. *See* Jennifer M. Granholm, *A Jobs Race to the Top*, GOLDMAN SCHOOL OF PUB. POL'Y (Oct. 1, 2013), http://gspp.berkeley.edu/news/news-center/a-jobs-race-to-the-top.

184. Flint, *supra* note 182.

185. *See* Camilla A. Hrdy, *Cluster Competition*, 20 LEWIS & CLARK L.J. 981 (2016).

186. Posner, *supra* note 144, at 44; *see also* Schragger, *supra* note 161, at 1860 ("That state and local governments are valuable as laboratories of experimentation is a popular assumption . . . .") (citing New State Ice Co. v. Liebmann, 285 U.S. 262, 310–11 (1932)).

187. Posner, *supra* note 144, at 45.

188. *See, e.g.*, Camilla A. Hrdy, *Dissenting State Patent Regimes*, 3 IP THEORY 78, 87 (2013) (arguing that one benefit of state patent regimes is that states could "generate troves of valuable information about the effects of patents in the marketplace and . . . begin to experiment with designing patent laws that work more effectively"); Hrdy, *State Patent Laws in the Age of Laissez Faire*, *supra* note 25, at 489 ("Especially given the continued move towards global uniformity, patent law could benefit from the policy experiments that divergent state patent regimes would produce, turning the states into decentralized 'laboratories' for improving the functioning of patent law."); Lisa Larrimore Ouellette, *Patent Experimentalism,* 101 VA. L. REV. 65, 68 (2015) (arguing that U.S. patent policy "should focus not on uniformity, but rather on improving innovation incentives through an evidence-based approach that depends on policy diversity").

189. Ouellette, *supra* note 188, at 68.

benefits of their policy experiments?[190] Consequently, like Cooter and Siegel, this Article focuses primarily on the issue of which government has the better incentives to adopt which kinds of policies—which, in turn, boils down to the question of which level of government is the smallest jurisdiction that can actually internalize the benefits of those policies.[191]

That said, assuming local governments do have sufficient incentives to experiment, this is another boon of localized governance in innovation policy. The diversity of programs discussed in Part V indicates that state governments in the United States *are* engaging in significant experimentation in terms of the amount, type, and particular design of innovation incentives. Moreover, there appears to be a significant amount of replication between states. At a National Academy of Sciences (NAS) symposium in 2009, local officials from a number of states (New York, Pennsylvania, Virginia, South Carolina, Kansas, Ohio, Washington, California, and Arizona) came together in Washington, D.C., to share specific strategies for growing innovation clusters. As described by rapporteur Charles Wessner in his report following the NAS symposium, "These initiatives can be seen as an ongoing experiments that can yield valuable insights on the role and limits of public policy in encouraging cluster-based economic growth and development."[192]

Maryann P. Feldman, whose work on "state science policy experiments" Section V.B.2(b) discusses, has explicitly stressed states' propensity to engage in experimentation in innovation policy design and to learn from one another's experiences. On the other hand, Feldman observes, replication is not always a boon. States' tendency "to attempt to follow the same strategies or develop industries that are similar to those established in other places" has downsides.[193] "While it appears to be easier to follow the lead of another place," Feldman writes,

190. Hrdy, *Dissenting State Patent Regimes*, *supra* note 188, at 83 (noting that state patents would generate " 'innovation spillovers' for innovators and competitors across the country."); *see also* Ouellette, *supra* note 188, at 86–87 (noting that "unconstrained 'laboratories' may under-innovate due to the externalities of both innovation itself (jurisdictions also do not internalize [all] the benefits of innovation policy) and innovation about innovation (jurisdictions also do not internalize the benefits of policy experiments"); Brian Galle & Joseph Leahy, *Laboratories of Democracy? Policy Innovation in Decentralized Governments*, 58 EMORY L.J. 1333, 1335 (2009) ("State and local governments can be thought of as inventors without patents: because anyone can steal their new ideas, what incentive have they ever had to invent?").

191. *See* Cooter & Siegel, *supra* note 14, at 137–38.

192. WESSNER, *supra* note 2, at 9.

193. Feldman, *Location, Location, Location*, *supra* note 179.

> [T]his strategy certainly does not ensure success. Many emerging clusters within the United States and around the world often look to the successes of Silicon Valley and Route 128 as they attempt to promote their emerging economy. What can often be their downfall, however, is that these emerging clusters try to replicate the actions of the leading economies rather than fill a new niche by diversifying.[194]

Therefore, one should take the benefit of more local innovation policy experiments with a grain of salt. As Wessner puts it in his remarks at the NAS symposium, it is helpful for local officials to learn what worked or failed elsewhere, and to extract "broader principles" from "analysis of the creation of clusters."[195] Wessner identifies three such principles: the presence of localized knowledge, a skilled workforce, and the availability of capital; opportunities for entrepreneurship and collaboration; and the presence of "appropriate incentives."[196] But, Wessner stresses, just as no two regions are identical, there is "no ready formula for recreating an innovation cluster."[197]

### D. LIMITATIONS

The economic federalism model has significant limitations. The most obvious limitation is spillovers. As explained, the main justification for intervention by a national government is "collective action failure" among local governments caused by inter-jurisdictional externalities.[198] Even when a public good is seemingly as geographically localized as a bridge or a cobblestone street, "local governments *never* fully internalize the costs and benefits of their local economic policies."[199] As shown below, local innovation policies can lead to externalities, both positive and negative, that necessitate national intervention through subsidy, preemption, or other regulations.[200]

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194. *Id.*

195. WESSNER, *supra* note 2, at 8.

196. *Id*. at 5 (categorizing these ingredients as capabilities, opportunities, and incentives) (citing MAGGIONI, *supra* note 54).

197. *Id*.

198. *See* Cooter & Siegel, *supra* note 16, at 118–19; Inman & Rubinfeld, *supra* note 144, at 45–48.

199. Schragger, *supra* note 166, at 1859 (emphasis added); STIGLITZ, *supra* note 151, at 737.

200. *See* Allen Erbsen, *Horizontal Federalism*, 93 MINN. L. REV. 493, 522–25 (2008) (discussing negative and positive interstate externalities).

*1. Positive Externalities*

The first type of externality is positive. Knowledge generated in one state may spill over to other states *very quickly,* before the sponsoring state can capture any of the benefits. Without the option for federal funding, states may not fund these "high-spillover" innovations. Section V.B.1 discusses precisely which kinds of innovation are currently funded by the national government. First, states are unlikely to independently fund basic research in fields like physics and anthropology that have little near-term commercial relevance.[201] Second, states are also unlikely to fund research related to "national public goods," such as national security or public health, absent the chance to win federal research contracts. In short, one can make the following generalization: states' incentive to invest in innovation is at its peak when the innovation is likely to engage the private sector and create concrete economic "wins" for the regions: employment, tax revenues, local investment, etc.[202]

What should one do when externalities deplete states' incentives to invest in research that nonetheless has high social value for the national as a whole? The answer, according to Wallace Oates,[203] is that the federal government should provide matching funds. As alluded to, the basic principle of fiscal federalism is that "the lowest level of government encompassing, in a spatial sense, the relevant benefits and costs" should be responsible for financing public goods.[204] However, this principle prescribes matching grants from the national government, or whichever government benefits, in cases where "the provision of local services generates benefits for residents of other jurisdictions."[205] This suggests a simple prescription: state innovation finance must be supplemented by

201. *See* DAN BERGLUND & CHRISTOPHER COBURN, PARTNERSHIPS: A COMPENDIUM OF STATE AND FEDERAL COOPERATIVE TECHNOLOGY PROGRAMS 15 (1995) ("For example, state cooperative technology programs rarely support basic research because its results are so easily diffused before any special benefit can be gained (biotechnology can be an exception to this rule).").

202. *Id*. (noting that, historically, states' desire to capture economic benefits from their expenditures on innovation has "drive[n] states toward industrially related technology fields where new products and processes can be readily deployed by companies resident in the state").

203. Oates's work on fiscal federalism heavily influenced Cooter and Siegel's collective action federalism theory. *See* Cooter & Siegel, *supra* note 16, at 137 n.102 (citing OATES, FISCAL FEDERALISM (1972)).

204. Oates, *supra* note 144, at 1122.

205. *Id.* at 1127.

robust federal funding of high-spillover innovations with little near-term commercial potential.[206]

The existence of federal funding for research can have a significant impact on the economy of the region in which federal grant recipients locate. For example, following World War II, some regions of California developed their economies thanks to sizeable federal investments in defense research based at U.C. San Diego.[207] Therefore, it should not be surprising that today many states fund public research partly to attract federal research grant recipients to the region.[208] Section V.B.2 discusses this phenomenon further.

*2. Negative Externalities*

Local governments can also impose *negative* externalities on other regions. There are two types of negative externality problems. The first is distortion: where states' investments in innovation lead to reduced private investments in innovations of national importance. For instance, imagine that Florida subsidizes a boat-hull design that has been in the public domain for years but requires further incentive to achieve successful commercialization. While subsidizing the boat-hull design does not directly harm states other than Florida, it could theoretically lead to more investment in boat-hulls, and less investment in, say, innovations in clean energy—thereby reducing national welfare.[209]

The second negative externality problem is the zero-sum game: where states become enmeshed in a zero-sum competition for talent, capital, and other scarce inputs to innovation and this competition results not in a net

206. *Id.*; *see also* Inman & Rubinfeld, *supra* note 144, at 46.

207. *See* Mary Walshok & Joel West, *Serendipity and Symbiosis: UCSD and the Local Wireless Industry*, *in* PUBLIC UNIVERSITIES AND REGIONAL GROWTH: INSIGHTS FROM THE UNIVERSITY OF CALIFORNIA 126–52 (Martin Kenney & David Mowery eds., 2014) (discussing the role of defense funding during World War II in the development of the wireless communications industry cluster in San Diego).

208. This raises the possibility of wasteful competition among states for federal research dollars—a problem I discuss in a recent paper. *See* Hrdy, *Cluster Competition*, *supra* note 185.

209. This was the Supreme Court's concern in *Bonito Boats v. Thundercraft Boats*, where the Court stated that state patents for unpatentable innovations might preclude investments in more innovative subject matter, and consequently decided to preempt state "patent-like rights." *See* 489 U.S. 141, 150–61 (1989). *But see* Douglas G. Lichtman, *The Economics of Innovation: Protecting Unpatentable Goods*, 81 MINN. L. REV. 693, 713–18 (1997) (challenging the Supreme Court's assumption about the effect of state incentives for unpatentable innovations on innovation).

benefit for all states, but a net loss.[210] As explained above, one implication of the economic federalism literature is that local governments craft incentives in a highly competitive atmosphere in which mobile residents choose among jurisdictions based partly on the different policies and services available. Local governments may therefore be tempted to design incentives whose main purpose is to lure away firms and talent from other places. For instance, Nevada passed a law in 2014 authorizing $1 billion in tax breaks for Tesla motor company to build a new facility to test and manufacture a new kind of electric car battery. The explicit purpose of this incentive was to encourage Tesla to locate its factory in Nevada rather than California or Michigan. Many doubt whether Tesla really needed that billion dollars for any reason other than to motivate its selection of Nevada over other states.[211]

While this inter-jurisdictional competition can theoretically lead to efficiencies in the form of more effective local policy and propitious clustering of residents with similar preferences,[212] it can also lead to wasteful spending and purposeless movements from one state to another.[213] Consequently, several commentators have asserted that negative impacts on

210. *See* Peter Enrich, *Saving the States from Themselves: Commerce Clause Constraints on State Tax Incentives for Business*, 110 HARV. L. REV. 377, 377–95 (1996) (arguing that the states have become trapped in a zero sum competition for mobile firms and that this has led them to waste money on tax incentives that have little positive impact on local or national welfare); *see also* Schragger, *supra* note 166, at 1854 (noting that a questionable assumption of "market-preserving federalism" theory is that local policies geared towards "maximizing local revenue" will "do more than simply move existing economic development from old territories to new ones [and will] instead, induce new economic growth, either in the local jurisdiction or in the nation as a whole"); Kirk Stark & Daniel J. Wilson, *What Do We Know About the Interstate Economic Effects of State Tax Incentives?*, 4 GEO. J.L. & PUB. POL'Y 133 (2006) (examining empirical evidence regarding the effects of state tax incentives on other states).

211. Matthew Wald, *Nevada Woos Tesla Plant in Tax Deal, but Economic Benefits Prompt Debate*, N.Y. TIMES, Sept. 12, 2014, at B1.

212. For example, it could be that the $1 billion incentive package signaled to Tesla that Nevada was a superior location in which to conduct its electric car manufacturing and that Nevada values Tesla more highly than the other competing states. For this argument, see Clayton P. Gillette, *Business Incentives, Interstate Competition, and the Commerce Clause*, 82 MINN. L. REV. 447, 457–63 (1997) (arguing that state incentives for businesses facilitate efficient competition for scarce resources and helps allocate those resources to the most suitable region that values them most highly).

213. *See, e.g.*, Enrich, *supra* note 210, at 377–81.

the states as a whole justify judicial preemption of state innovation incentives under the Dormant Commerce Clause.[214]

Of course, it's very difficult for economists, let alone a court, to distinguish between illegitimate "raiding" of other states, and a value-adding innovation strategy. As more data is gathered, it could be possible to distinguish between incentives that lead to more productive activity than we would otherwise have and incentives that do nothing more than shift already-productive activity from one state to another.[215]

### *3. Immobility and Broken Political Process*

For a variety of reasons—capture by powerful interest groups,[216] lack of information, corruption, or simple incompetence—local officials may not design high quality, public-spirited innovation policies. Specifically, with respect to innovation finance, they may invest public money in innovations that do not pan out or that require no incentive in the first place. In these situations, the region will not experience economic benefits from the innovation or, if it does, the benefits will not make up for the lost revenues (i.e., this is deadweight loss). Unfortunately, the economic federalism model does not strictly care about the local costs of poorly crafted local innovation policies so long as the effects are confined to the jurisdiction. This is because the economic federalism theories presented above—that local officials have better incentives to craft local innovation policies, and that mobile firms, capital, and talent will sort themselves into efficient clusters—rely on two key assumptions about the local political process.

The first assumption is that residents are effectively mobile and constantly seeking alternative locations with superior policies.[217] The second assumption is that a functioning democratic process forces local

214. *See, e.g., id.* at 381, 422–67 (arguing that the Dormant Commerce Clause restricts states' authority to use tax incentives as location incentives and urging the Supreme Court to adopt this view).

215. An example of promising new empirical research is Daniel Wilson's work on state R&D tax credits. *See, e.g.*, Daniel J. Wilson, *Beggar Thy Neighbor? The In-State, Out-of-State, and Aggregate Effects of R&D Tax Credits*, 91 REV. ECON. & STAT. 431 (2009); *see also* Camilla A. Hrdy, *Moretti & Wilson: Do State Innovation Incentives Work?*, WRITTEN DESCRIPTION (Aug. 23, 2013), http://writtendescription.blogspot.com/2013/08/moretti-wilson-do-state-incentives-for.html.

216. *See* DANIEL CARPENTER & DAVID MOSS, PREVENTING REGULATORY CAPTURE: SPECIAL INFLUENCE AND HOW TO LIMIT IT 13–14 (2014) (defining regulatory capture as the result or process by which regulation is consistently directed away from the public interest by the intent of industry itself).

217. Tiebout, *supra* note 173, at 419 (stating that his model is based on the assumption that "[c]onsumer-voters are fully mobile and will move to that community where their preference patterns, which are set, are satisfied").

officials to act in the public interest.[218] As Weingast puts it, because the mobility of capital and labor limits officials' ability to cater to minority interests, federalism "greatly diminishes the level and pervasiveness of rent-seeking and the formation of distributional coalitions."[219] The upshot, for our purposes, is that bad innovation policies risk innovators leaving or not entering the state and risk politicians being voted out of power by existing residents.

While I recognize commentators' arguments that these assumptions do not always hold true in practice, it is beyond the scope of this Article to defend or reject the entire economic federalism model.[220] My conception of local governments' role in innovation policy is an ideal to strive for if not always a reality.

*4. A Note on Geographic Inequality*

A very different kind of problem is severe geographic inequality. Economic federalism's main interest is in promoting efficiency in policy design and provisioning of public goods. As just explained, it achieves this goal by assuming that residents' willingness to pay taxes and remain in the jurisdiction will produce those policies in practice. If Kansas needs a new university, Kansas shall have it. If angel investors refuse to come to the jurisdiction unless they can get a tax credit for investments in not-yet-profitable start-ups, the state will offer it, especially if other states are already doing so.

But in reality, not everyone—and not every state—has the same ability to actually pay for what it desires. Different locations across the United States have different constitutions of residents, some with much lower ability to pay for effective innovation policies than others. Kansas may not actually be able to fund a new university and angel tax credits through tax policy or by taking on debt, even if Oklahoma or Massachusetts can. Economic federalism does not strictly care about this problem. So long as inter-jurisdictional competition for residents results in several high-

218. Cooter & Siegel, *supra* note 14, at 138 (asserting that local officials are effectively monitored by local residents); *see also* Weingast, *The Economic Role of Political Institutions*, *supra* note 167, at 5–6 (discussing the limits the threat of flight places on political actors).

219. Weingast, *The Economic Role of Political Institutions*, *supra* note 167, at 6.

220. *See* Schragger, *supra* note 161, at 1853–54 (critiquing Weingast's assumption that competition limits predation); *see also* David Schleicher, *Federalism and State Democracy*, 95 TEX. L. REV. (forthcoming 2017) (noting that each of the common justifications for federalism requires "state democracy to actually function"), draft available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2739791##.

performing innovation clusters across the country in different technology areas, it does not matter whether there are losers in this race.

As discussed in Section II.C, the United States is already to some degree divided into "dominant clusters" that "continually pull in firms, entrepreneurs and workers," and "lower tier regions" that find it "difficult . . . to break into the dominant groups."[221] Should the federal government start to intervene? At what point do we decide as a national taxpaying body that—regardless of efficiency—this division between "dominant" and "lower tier" regions results in a level of geographic inequality that is socially undesirable?

I address these difficult questions in a separate article, where I show that beginning around 2010 the federal government has begun to intervene in the local competition to grow clusters by providing subsidies and other opportunities to help selected regions craft effective innovation policies.[222] For example, in 2010, the America COMPETES Reauthorization Act authorized a new regional innovation program to assist state and local governments in developing clusters in selected technology areas. The Act explicitly gives preference to underdeveloped regions negatively impacted by trade.[223] I argue that federal involvement in cluster competition can be justified based both on distributional concerns and based on efficiency. Not unlike the patent system, federal subsidies for regions to innovate in selected technology areas can theoretically prevent duplicative investments in research and technology development and limit rent-dissipating competition to be the next Silicon Valley.

## V. FEDERAL AND STATE INNOVATION POLICY IN PRACTICE

Part IV addressed how theories of economic federalism suggest U.S. innovation policy *ought* to be structured. Collective action federalism and its guiding internalization principle mandate a different conclusion depending on which type of innovation policy we select: intellectual property rights, on the one hand, or innovation finance, on the other. If patents are selected, jurisdiction is more likely to be national or even global due to the problem of spillovers. But if innovation finance is selected,

221. *See* Karen G. Mills, Andrew Reamer & Elisabeth B. Reynolds, *Clusters and Competitiveness: A New Federal Role for Stimulating Regional Economies*, BROOKINGS INST. (Apr. 2008), at 12, https://www.brookings.edu/wp-content/uploads/2016/07/Clusters-Brief.pdf.

222. *See* Hrdy, *Cluster Competition*, *supra* note 185.

223. *See* America COMPETES Reauthorization Act of 2010, Pub. L. 111-358, § 603, 124 Stat. 3982, 4030–37 (2011) (codified as amended at 15 U.S.C. § 3722 (2012)).

jurisdiction should often be local since the economic benefits of innovation are highly localized to the region in which researchers, firms, and skilled workers locate.

This final Part is largely descriptive. I show that the internalization principle—which assigns authority to the smallest jurisdiction that internalizes the benefits of its policies and reserves national action for collective action failure—is a remarkably good descriptor for how federal and state governments actually respond to the problem of promoting innovation in their respective jurisdictions. Patent law is purely federal law and has become increasingly so over the centuries. Innovation finance is offered concurrently by national and local governments. With respect to commercial innovations for which there is already a private market and the potential for localized benefits is high, the innovation finance options are far more extensive at the state and local level.

## A. PATENT LAW

Collective action federalism theory works very well for patent law. As I show below, patent law's jurisdictional trajectory from state to federal rights seems to have been explicitly motivated by the problem of spillovers: cross-border copying of inventions protected in other states. Protecting patents, along with copyrights, may well represent a collective action failure that necessitates federal intervention under the IP Clause, just as Cooter and Siegel contend.[224] On the other hand, states' retrenchment from patent law stands in stark contrast with states' historic and continuing role in protecting businesses' trade secrets from misappropriation.

### *1. From State to Federal Rights*

Prior to ratification of the Constitution in 1788, U.S. states had their own patent laws.[225] However, the advent of interstate commerce challenged the efficacy of state-level patent regimes. Inventors ceased to be able to effectually protect their rights within a free-trading national marketplace.[226] When the time came to draft a Constitution laying out the powers of the new federal government, no one appeared to object to James Madison's famous statement in *The Federalist* No. 43 that "[t]he States cannot separately make effectual provision for either . . . [patent or copyright] cases."[227] Thereafter, the Framers added the IP Clause to the Constitution with little discussion of

224. Cooter & Siegel, *supra* note 16, at 148–49.
225. *See* Hrdy, *State Patent Laws in the Age of Laissez Faire*, *supra* note 25, at 58–67.
226. *Id.* at 67–70.
227. THE FEDERALIST NO. 43, at 279 (James Madison) (Clinton Rossiter ed., 1961).

the matter. In 1790 and 1793, two federal patent acts passed in rapid succession.[228] A few states, such as New Hampshire and New Jersey, continued granting patents after ratification, but the Patent Act of 1793 clarified that these patents would be automatically relinquished upon obtaining a federal patent.[229]

In 1836, Congress created a national Patent Office to review applications and issue granted patents.[230] The creation of a national Patent Office appeared to complete the federalization of the substance of patent law. Under the post-1836 system, writes Herbert Hovenkamp, "[t]he federal patent . . . evolved into a 'property right' that applicants could obtain through an administrative procedure intended to be politically neutral, and that patentees could practice or not at their will."[231] Meanwhile, Hovenkamp recounts, states' role in the creation of property rights in inventions, as compared to corporate charters or other exclusive franchises, appeared minimal. Even as the granting of exclusive rights in corporate charters "remained largely a function of the states . . . the power to grant exclusive rights for inventions came to be seen as a federal prerogative."[232]

This trend towards patent federalization makes sense from the perspective of the efficiency values underlying collective action federalism. The fundamental problem was that patent disclosures produced a severe inter-jurisdictional externality: benefits for other states at the expense of the state that offered the patents and copyrights.[233] Prior to the existence of national patents, creators were forced to apply for rights in all states in which they sought to market their invention or enforce their rights. This was

228. *See* Patent Act of 1790, ch. 7, 1 Stat. 109 (1790) (repealed 1793); Patent Act of 1793, ch. 11, 1 Stat. 318 (1793) (repealed 1836).

229. Patent Act of 1793, ch. 11, § 7, 1 Stat. 318, 322 (1793); *see* Hrdy, *State Patents in the Age of Laissez Faire, supra* note 25, at 72–74, 77.

230. *See* Patent Act of 1836, ch. 357, § 18, 5 Stat. 117, 124 (1836) (repealed 1861).

231. Herbert Hovenkamp, *The Emergence of Classical Patent Law in American Legal Thought*, 58 ARIZ. L. REV. 263, 270 (2016).

232. *Id.* at 278. Corporate charters were different from federal patents because they created exclusive rights to operate an enterprise, such as a bridge or a toll road, in a physical space. On state monopolies in the nineteenth century, see Herbert Hovenkamp, *Technology, Politics, and Regulated Monopoly: An American Historical Perspective*, 62 TEX. L. REV. 1263, 1268 (1984).

233. *See* Hrdy, *State Patents as a Solution, supra* note 20, at 83 (noting that "state patents would . . . generate valuable 'innovation spillovers' for innovators and competitors across the country"); *see also* EDWARD WALTERSCHEID, THE NATURE OF THE INTELLECTUAL PROPERTY CLAUSE: A STUDY IN HISTORICAL PERSPECTIVE 76 (2000) ("The most singular defect was that states could only legislate with respect to their own territory.").

costly from the perspective of rights owners, and it was risky from the perspective of states.[234]

The problem could potentially have been resolved through inter-state bargaining. But this solution faced significant transaction costs, requiring an agreement among up to fifty states, each of which had an incentive to cheat by continuing to allow copying of the productions of their neighbors. As explained in Part IV, economic federalism theory favors nationalizing when the transaction costs implicated by inter-state bargaining are very high.[235] Thus, patents and copyrights should, at a substantive level, generally be national rights to avoid the inefficiencies of bargaining between states.[236]

That said, as I have previously shown, there are nonetheless instances in which states could productively grant patents for geographically localized innovations, such as advancements in agricultural technology, water conservation, or energy production. Unlike in copyright, patentable subject matter often has significant geographic dimensions and utility can vary from place to place.[237] Markets for inventions may be limited to the region, as in the case of some agricultural innovations. Because commercialization in the patent context is difficult, the availability of a U.S. patent alone does not always ensure practice and implementation; a state patent could improve a developer's incentive and ability to undertake local

234. *See* Hrdy, *State Patent Laws in the Age of Laissez Faire, supra* note 25, at 67–70; WALTERSCHEID, *supra* note 233, at 76 ("Getting multiple state patents or copyrights was time consuming, expensive, and frequently frustrating.").

235. Cooter & Siegel, *supra* note 16, at 139–40 (discussing the "Federal Coase Theorem").

236. Efficiency also likely weighs against giving state courts concurrent authority to make determinations of patent validity and infringement, though an analogy could be drawn to the dual system we currently have in which the Patent Trial and Appeals Board (PTAB) makes determinations of validity alongside federal courts. *See* Ben Picozzi, Comment, *Finality in Parallel Patent Proceedings*, 125 YALE L.J. 2519 (2016). On the gradual demise of state courts' concurrent authority to entertain patent lawsuits, see Paul Gugliuzza, *Patent Law Federalism*, 2014 WIS. L. REV. 11, 17–19 (2014). *But see id.* at 27–75 (challenging the prevailing assumption that federal courts should have exclusive jurisdiction in cases arising under patent law); Edward Cooper, *State Law of Patent Exploitation*, 56 MINN. L. REV. 313, 318–24, 344–73 (1972) (discussing various types of cases where state courts have historically been called upon to determine patent-related issues arising under tort and contract, and even to determine the scope and validity of patents).

237. *See* Goldstein v. California, 412 U.S. 546, 556–57 (1973) ("The patents granted by the States in the 18th century show, to the contrary, a willingness on the part of the States to promote those portions of science and the arts which were of local importance.").

commercialization of high cost, high-risk ventures.[238] Thus, I have previously argued that in certain circumstances states should be able to grant their own domestic patent rights in exchange for the promise to commercialize innovations of high local utility to the jurisdiction.[239] The result should be more commercialization of socially valuable localized technologies as well as potentially useful experiments in patent law and policy.[240]

*2. A Contrast with Trade Secrets*

The internalization principle comes to a very different result for forms of intellectual property that do not implicate broad disclosure of new and easily transferable information. Patents correct for the externalities involved in innovation by creating exclusive rights, but they do so only for new and nonobvious inventions *that are fully disclosed in a patent document*.[241] Trade secrets, in contrast, protect information that is by definition nonpublic—that is, information that has never been disclosed to the public at large, and that has been kept secret using reasonable efforts—and they only protect against "improper" acquisition, use, or disclosure of that information.[242] Thus, unlike patents, trade secrets do not inevitably implicate severe inter-state spillover of easily transferable information. To

238. Hrdy, *State Patents as a Solution*, *supra* note 20, at 116–19 (discussing the potential role of a state patent in promoting commercialization).

239. *Id*. at 102–103.

240. *Id*. at 103 ("Especially given the continued move towards global uniformity, patent law could benefit from the policy experiments that divergent state patent regimes would produce, turning the states into decentralized 'laboratories' for improving the functioning of patent law.").

241. Patent law's longstanding disclosure requirement has two functions: to "permit society at large to apply the information by freely making or using the patented invention after the expiration of the patent," and to "stimulate others to design around the invention or conceive of new inventions—either by improving upon the invention or by being inspired by it—even during the patent term." Jeanne Fromer, *Patent Disclosure*, 94 IOWA L. REV. 439, 458–59 (2009).

242. *See generally* UNIF. TRADE SECRETS ACT § 4 (amended 1985), 14 U.L.A. 536–59 (2005); *see also* Kewanee v. Bicron, 416 U.S. 470, 484 (1974) ("By definition a trade secret has not been placed in the public domain."); E. I. duPont deNemours & Co. v. Christopher, 431 F.2d 1012, 1016 (5th Cir. 1970) (applying Texas law) ("DuPont has a valid cause of action to prohibit [the defendant] from improperly discovering its trade secret and to prohibit the undisclosed third party from using the improperly obtained information."). *But see* Michael Risch, *Hidden in Plain Sight*, 31 BERKELEY TECH. L.J. (forthcoming 2017) (asserting that in actuality "[a] long line of cases—in virtually every circuit—provides for the protection of trade secrets in products sold to the public"), draft available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2761100.

the contrary, while patents *promote* disclosure of information, trade secrets *prevent* disclosure of information.

In line with this prediction, trade secret law is the only IP regime that remains primarily state law.[243] Trade secret laws originated in disparate state common law rules.[244] They were eventually made more uniform beginning with the American Law Institute's (ALI) *Restatement (First) of Torts* (1939) and culminating with the Uniform Trade Secrets Act (UTSA) in 1979, which has been adopted in forty-seven states.[245] The Supreme Court has held that states wishing to use trade secret laws to provide incentives for non-patentable subject matter can do so, as long as they limit protection to innovations that have not yet been publicly disclosed and do not prevent reverse engineering.[246]

This allocation of power has now shifted. Congress has passed a federal *civil* cause of action for trade secret misappropriation under federal law.[247] The major function of the Defend Trade Secrets Act (DTSA) is to broaden the scope of trade secret protection in actions involving extraterritorial conduct and to facilitate enforcement in situations involving multiple states.[248] The driving motivation is clear: to provide a more efficient

243. *See* Robert Denicola, *The Restatements, the Uniform Act and the Status of American Trade Secret Law*, *in* THE LAW AND THEORY OF TRADE SECRECY 18 (Rochelle C. Dreyfuss & Katherine J. Strandburg eds., 2011) (noting that unlike patent, copyright, and trademark law, "[t]rade secret law, however, is state law").

244. *Id*. at 18–22; *see also* ELIZABETH ROWE & SHARON SANDEEN, CASES AND MATERIALS ON TRADE SECRET LAW 14–15 (1st ed. 2012).

245. *See* Denicola, *supra* note 243, at 20–21, 33–44 (discussing the UTSA's adoption and its effect on preexisting common law protections).

246. As the Court observed in *Kewanee v. Bicron* (1974), where it rejected a challenge to the constitutionality of state trade secrets laws under the Supremacy Clause, there is no inherent reason states cannot perform these functions for the benefit of industry. "Trade secret law," the Court stated, "encourages the development and exploitation of those items of lesser or different invention than might be accorded protection under the patent laws . . . . Until Congress takes affirmative action to the contrary, States should be free to grant protection to trade secrets." 416 U.S. at 493.

247. Defend Trade Secrets Act of 2016, Pub. L. No. 114-153, 130 Stat. 376 (2016) (to be codified at 18 U.S.C. §§ 1832(b), 1833, 1835, 1836(b)-(d), 1839(3)-(7)); *see also* Christopher Seaman, *The Case Against Federalizing Trade Secrecy*, 101 VA. L. REV. 317, 320 (2015) (arguing federalization is unnecessary in light of state protection and criminal liability under the EEA); David Levine & Sharon Sandeen, *Here Come the Trade Secret Trolls*, 71 WASH. & LEE L. REV. ONLINE 230 (2015) (arguing federalization risks spawning new forms of "trolling behavior"). *But see* James Pooley, *The Myth of the Trade Secret Troll: Why We Need a Federal Civil Claim for Trade Secret Misappropriation*, 23 GEO. MASON L. REV. 1045 (2016) (arguing that national trade secret protection is both necessary and efficient).

248. *See* Seaman, *supra* note 247, at 340–48.

mechanism to keep knowledge generated in U.S. borders in the country, and to enable individual states to more effectively protect the trade secrets of local companies.[249]

Federalization was not without its critics. For example, Christopher Seaman argues that federalization was unnecessary, given that state trade secret laws already exist and are nearly uniform; moreover, parties can already access a federal forum in cases involving citizens from different states, including foreign states.[250] Seaman also worries that federalizing trade secret law will make trade secret protections far stronger as compared to patent law, leading to an increase in secrecy and a reduction in patenting and public disclosure.[251] Lastly, Seaman suggests that states should be allowed some flexibility to experiment in trade secret law.[252]

Collective action federalism provides a more fundamental reason for objecting to complete federalization. Rather than asking whether a national trade secret law would make trade secret protection weaker or stronger, the theory looks instead at what would be the most efficient allocation of government. In this case, the knowledge spillovers potentially created by the production trade secret information within a firm will often be localized. Even in the digital age, most trade secret theft is performed by insiders, "typically involving alleged breaches of confidence in the context of business-to-business and employer–employee relationships."[253] Many of these thefts will result in involuntary knowledge transfers—but only to other employees or companies in the region. Even in cases where employees leave a state for another state within the U.S., there is no inherent reason that state or federal courts cannot obtain jurisdiction over the departing employee, just as they do in ordinary tort cases.[254]

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249. *See* Pooley, *supra* note 247, at 3 ("[F]ederalizing trade secret law would fill a critical gap in effective enforcement of private rights against cross-border misappropriation that has become too stealthy and quick to be dealt with predictably in state courts.").

250. Seaman, *supra* note 247, at 369–70 (noting that diversity jurisdiction covers cases brought by U.S. corporations against citizens of foreign states, "which is particularly useful in cases involving trade secret misappropriation by foreign entities").

251. *Id.* at 379–85; *see also* Camilla A. Hrdy, *Seaman: The Case Against Federalizing Trade Secrecy*, WRITTEN DESCRIPTION (Apr. 30, 2014), http://writtendescription.blogspot.com/2014/04/seaman-case-against-federalizing-trade.html.

252. Seaman, *supra* note 247, at 322 ("[T]here are benefits to a decentralized approach that permits states to engage in a limited degree of experimentation regarding the scope of trade secret protection.").

253. Levine & Sandeen, *supra* note 247, at 239–40 ("The existing data establishes that the bulk of all trade secret cases are of the domestic variety . . . .").

254. *See, e.g.*, Clorox v. S.C. Johnson & Son, Inc., 627 F. Supp. 2d 964, 972 (E.D. Wis. 2009) (denying motion for temporary restraining order and injunction to prevent an

There is one very important exception where states cannot internalize the benefits of their trade secrets laws: when someone misappropriates information leaves the state's jurisdiction—taking the trade secret with them. For example, if a firm in New Jersey hires employees from Taiwan, and these employees leave the country in possession of the firm's trade secrets, New Jersey may have difficulty obtaining jurisdiction over the defendants or obtaining a remedy under Taiwanese law. Unless the state can obtain extraterritorial jurisdiction, this represents a positive spillover to a non-U.S. country that state law is not competent to address.[255] Depending on the transaction costs of bargaining with other countries to expand extraterritorial protection for trade secrets, the collective action principle suggests that nationalization is appropriate *in the specific case of foreign espionage.*

This too tracks reality. Even before the DTSA was passed, the United States had a criminal remedy in place for misappropriations that implicate cross-border spillovers. As Elizabeth Rowe and Daniel Mahfood have discussed, "[i]nternational espionage of American trade secrets" has become a "growing problem with wide-ranging significance implicating national security, economic, and political interests."[256] In response, Congress passed the Economic Espionage Act (EEA) in 1996,[257] primarily to confront the threat of foreigners leaving the United States with the secret information of American companies.[258] That said, the EEA allows only criminal causes of action, and the decision to prosecute is subject to the discretion of U.S. Attorneys. Thus, the EEA remained "a limited option for private companies."[259]

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employee based at a California company from revealing confidential information in his new employment at a Wisconsin company).

255. *See* Elizabeth Rowe & Daniel Mahfood, *Trade Secrets, Trade, and Extraterritoriality*, 66 ALA. L. REV. 63, 64 (2014) ("A primary obstacle to [protecting trade secrets abroad] is the principle of territoriality—the notion that U.S. law applies only to acts that take place on U.S. soil. As a consequence of this principle, American companies doing business abroad, or whose trade secrets are misappropriated abroad, have limited recourse against a potential infringer through either criminal or civil actions.").

256. *Id.* at 67.

257. Pub. L. No. 104-294, 110 Stat. 3488 (1996) (codified as amended at 18 U.S.C. §§ 1831-1839 (2012)).

258. The Act criminalizes espionage on behalf of a foreign entity and theft of trade secrets for pecuniary gain and also provides a criminal remedy for thefts that involve products sold in interstate commerce. Unlike state trade secret laws, the EEA applies to extraterritorial conduct by U.S. citizens and non-citizens and clearly targets theft involving either flight to a foreign country or action by foreign entities. 18 U.S.C. §§ 1831, 1832 (2012); *see also* Rowe & Mahfood, *supra* note 255, at 64, 102.

259. Rowe & Mahfood, *supra* note 255, at 64.

This limitation was not a flaw. As a matter of efficient allocation of government, it was appropriate to have a limited, targeted federal remedy to confront cross-border thefts that challenged state courts' jurisdiction and federal district courts' jurisdiction in diversity cases.[260] Given that there was no pervasive collective action failure requiring federal law in *every case* or even in the average case, economic federalism suggests that states should remain responsible for trade secret laws to obtain the benefits of local jurisdiction discussed above.[261]

Along with the desirability of some legal experimentation, discussed by Seaman, the theories discussed in Section III.C suggest two other reasons to retain state jurisdiction and allow for variation among the states when variation occurs.[262] First, according to the "market-preserving" federalism theory explained in Section III.C.1, states may simply have better incentives and better information to design trade secret laws that match the needs of specific industries and people within their jurisdictions. For example, one state may decide that intrastate norms and practices support strong trade secret protection when an employee has threatened to leave a firm but has not yet used or disclosed any secrets; other states might favor weaker trade secret protection in such circumstances.[263] Second, according to the theory of Tiebout clustering explained in Section III.C.2, firms and industries can choose which rule works better for them, leading to more efficient matching of firms to different jurisdictions and more efficient production within those jurisdictions and overall.

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260. Absent express authority from Congress, federal courts, like state courts, are limited by the long-arm statutes of the states in which they are located. *See* FED. R. CIV. P. 4(k)(1)(A) (stating that jurisdiction over defendants is proper where the defendant could be subjected to the jurisdiction of state courts in the state where the federal district court is located).

261. *See, e.g.*, Yoo, *supra* note 161, at 1402–03; *see also* Section III.C.

262. Note that even though most states have adopted the UTSA, there are still significant differences between states both statutory and common law. *See* Pooley, *supra* note 247, at 5–6 (discussing the lack of uniformity even within UTSA states and giving examples of divergent rules among the states).

263. California courts reject the "inevitable disclosure doctrine" on the grounds that it interferes with California's policy of free mobility and would create an "after-the-fact covenant not to compete" restricting employee mobility. *See, e.g.*, Les Concierges, Inc. v. Robeson, No. C-09-1510-MMC, 2009 WL 1138561 (N.D. Cal. Apr. 26, 2009). Pennsylvania courts, in contrast, allow protection in such circumstances. Insulation Group LLC v. Sproule, 613 F. Supp. 2d 844, 855 (S.D. Tex. 2009) (applying Pennsylvania law to grant an injunction without any evidence that the former employee had actually used or disclosed the former employer's trade secrets because it is "impossible for [the former employee] not to disclose [the] trade secrets").

The possibility of such benefits from localization of authority suggests that, since states *can* internalize the effects of prohibiting trade secret misappropriation within their own borders in many if not all cases, general civil trade secret law should remain state law. On the other hand, the new system takes a weak compromise, creating a federal civil trade secret law while declining to preempt state trade secret law.[264] There seems little reason to give litigants the option to bring both federal and state law trade secret claims when state law would be sufficient on its own. This seems a wasteful duplication of remedies.

### B. INNOVATION FINANCE

Thus, to sum up, patent law and now trade secret law have become federal law. Cross-border spillovers—that is, the risk of out-of-state copying or involuntary transfer of knowledge from one location to another—have been the main culprit. With respect to innovation finance, however, the situation is very different. Unlike IP rights, direct public financing of innovation does not operate through the mechanism of exclusion, and thus does not suffer from the same problem.[265]

This insight prevents the simple conclusion that innovation finance, like patents, should generally be national. Instead, the smallest jurisdiction that internalizes the benefits of innovation finance should be responsible. As explained in Section II.C, the near term, and even the long-term, benefits of innovation tend to be concentrated in the region in which innovators locate their research and operations and in which they employ workers at high-skill wages. In such cases, innovation finance should be the responsibility of the subnational region that actually experiences these benefits. There are exceptions to this rule. As noted in Section IV.D.1, the main exception is "high-spillover" research that does not create sufficient local economic benefits to justify local funding without the chance for national supplements.

In the sections below, I demonstrate that this prediction is borne out in practice by performing an in-depth investigation of the innovation incentives actually provided in the United States today at the federal and state levels.

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264. The DTSA does not preempt state law. Pub. L. No. 114-153, § 2, 130 Stat. 376, 381 (2016) (to amend 18 U.S.C. §§ 1833, 1836 (2012)) ("Nothing in the amendments made by this section shall be construed to modify the rule of construction under section 1838 of title 18, United States Code, or to preempt any other provision of law.").

265. *See supra* Section IV.B.

### *1. U.S. Federal Innovation Finance*

Innovation in the United States is driven primarily by the private sector. The total R&D performed for 2010-11 was over $400 billon. The private sector conducted around $284 billion of this amount, and funded around $248 billion of the total.[266] However, the U.S. federal government funds a significant amount of R&D every year. After World War II, the federal government significantly increased its share of funding for science and technology-based research.[267] Today the national government spends around $130 billion a year on research and development, around 30% of the national total.[268]

However, the cases where the federal government directly finances research are the exception rather than the rule. Federally funded research is limited to those cases in which innovation produces such significant national benefits that states alone are not be willing to fund it: basic science research with no market or known commercial relevance; R&D in specific national mission areas; and "dual use" funding for private enterprises innovating in those areas.[269] This Article argues that each of these circumstances entails significant national spillovers that justify at least some federal financing *despite* the fact that many of the economic benefits will be localized to the regions in which the research is performed.

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266. *See* Mark Boroush, *U.S. R&D Spending Resumes Growth in 2010 and 2011 but Still Lags Behind the Pace of Expansion of the National Economy*, NSF: INFO BRIEF, NAT'L CTR. SCI. & ENG'R STATISTICS (NSF 13-313, Jan. 2013), http://www.nsf.gov/statistics/infbrief/nsf13313/nsf13313.pdf; *see also* Mark Boroush, *National Patterns of R&D Resources: 2010-2011 Data Update*, NSF: NAT'L CTR. SCI. & ENG'R STATISTICS (NSF 13-318, Apr. 2013), http://www.nsf.gov/statistics/nsf13318/pdf/nsf13318.pdf. For discussions of the private sector as the main driver of innovation, see, for example, LERNER, *supra* note 27, at 150; SCOTCHMER, *supra* note 6, at 140–43; Keller, *supra* note 28, at 110–11.

267. LERNER, *supra* note 27, at 33, 20, 150–52.

268. NSF: NAT'L CTR. SCI. & ENG'R STATISTICS, FEDERAL FUNDS FOR RESEARCH AND DEVELOPMENT FYS 2012–14, tbl. 3, "Federal obligations for research, development, and R&D plant, by agency," https://www.nsf.gov/statistics/nsf14316/pdf/tab3.pdf. For an overview of federal funding for R&D, see David Mowery & Richard Rosenberg, *The U.S. National Innovation System*, *in* NATIONAL INNOVATION SYSTEMS: A COMPARATIVE ANALYSIS 29–75 (Richard Nelson ed., 1993); Fred Block, *Innovation and the Invisible Hand of Government*, *in* STATE OF INNOVATION: THE U.S. GOVERNMENT'S ROLE IN TECHNOLOGY DEVELOPMENT 4-30 (Fred Block & Matthew R. Keller eds., 2011).

269. BRANSCOMB & AUERSWALD, *supra* note 28, at 144. On the federal government's mission-oriented technology policy, see Lewis M. Branscomb & George Parker, *Funding Civilian and Dual-Use Industrial Technology*, *in* EMPOWERING TECHNOLOGY: IMPLEMENTING A U.S. STRATEGY 64, 69 (Lewis M. Branscomb ed., 1993); Maryellen Kelley, *From Core Mission to Commercial Orientation: Perils and Possibilities for Federal Industrial Technology Policy*, 11 ECON. DEV. Q. 313, 315–26 (1997).

a) Basic Science Research

Basic science research is research that has no known practical, commercial, or government application.[270] It is difficult for states to internalize the full value of basic science research because the resulting knowledge can be used by others outside the state either instantly or in the near future *without first creating localized economic benefits like employment or new firms*. Thus, the collective action failure principle suggests that funding must come from the national government rather than subnational governments.

This prediction holds true in practice. While states do fund some basic research—a phenomenon discussed in the next section—basic research with no defined commercial application relies heavily on federal subsidies. In 1950, Congress created the National Science Foundation (NSF), an independent federal agency whose mission is "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense . . . ."[271] The NSF funds much of the basic research (around 24%) performed at universities and is the only federal agency dedicated to supporting fundamental research and education in all scientific and engineering disciplines, except the medical sciences.[272] Supported research areas include the Biological Sciences, Mathematical & Physical Sciences, and Social, Behavioral & Economic Sciences.[273] The NSF has an annual budget of around $7.5 billion a year.[274]

b) Mission R&D

Besides basic research, the federal government funds R&D in selected subject matter areas relevant to national missions. The federal government administers most federal research money through national mission agencies with mandates to focus on specific research areas of high national relevance. Today the major mission agencies that fund research are the Department of Defense (DOD), the Department of Health and Human Services (HHS) (home to the National Institutes of Health (NIH)), the National Aeronautics

270. Sohvi Leih & David J. Teece, "Basic Research," THE PALGRAVE ENCYCLOPEDIA OF STRATEGIC MANAGEMENT (Mie Augier & David J. Teece eds., 2016) (defining the term).

271. NSF, ABOUT THE NATIONAL SCIENCE FOUNDATION, https://www.nsf.gov/about/ (last visited Feb. 9, 2016).

272. *Id.*

273. NSF, FIND FUNDING, https://www.nsf.gov/funding/index.jsp#areas (last visited Feb. 9, 2016).

274. NSF, ABOUT THE NATIONAL SCIENCE FOUNDATION, https://www.nsf.gov/about/ (last visited Feb. 9, 2016).

and Space Administration (NASA), the Department of Energy (DOE), the Department of Transportation (DOT), and the Department of the Interior (DOI). In addition, the National Institute for Standards and Technology (NIST), a relatively small agency in the Department of Commerce (DOC), receives around $850 million a year for programs oriented towards research and commercialization.[275] Federal R&D grants go to four main actors: private businesses; federal agencies, which perform intramural R&D in their own research facilities;[276] universities and colleges; and nonprofits.[277]

The table below lists the top four agencies through which the national government funds basic and applied research, and the federal funds provided to each agency in 2012. Of the approximately $130 billion that the federal government spends per year on research, *about half* goes towards defense research and domestic security. Health research comes in second, receiving around $30 billion a year.[278]

**Table 1: Federal Funding for R&D in Top Four Mission Areas in 2012 (in billions)**[279]

| | |
|---|---|
| DOD | $65.3 |
| HHS | $30.9 |
| NASA | $10.6 |
| DOE | $10.3 |

275. *See* NIST APPROPRIATIONS SUMMARY FY 2013 – FY 2015, https://www.nist.gov/director/congressional-and-legislative-affairs/nist-appropriations-summary-fy-2013-fy-2015; *see also* JOHN F. SARGENT JR., CONG. RESEARCH SERV., R43580, FEDERAL RESEARCH AND DEVELOPMENT FUNDING: FY 2015 5–6 tbl. 1, 48–51, tbl. 15 (2015) (providing recent data on federal funding for R&D and NIST specifically).

276. Rochelle Dreyfuss, *Tailoring Incentives: A Comment on Hemel and Ouellette's Beyond the Patents–Prizes Debate,* 92 TEX. L. REV. 131, 132 (2014) ("R&D spending by federal laboratories, such as the National Institutes of Health, is substantial. In 2009, for example, intramural spending amounted to $30.9 billion and constituted 8% of all U.S. R&D expenditures.").

277. *See* Boroush, *U.S. R&D Spending Resumes Growth in 2010 and 2011*, *supra* note 266, at 2, 4.

278. *Cf.* Adam Marcus & Ivan Oransky, *Getting the Bogus Studies Out of Science*, N.Y. TIMES, Aug. 20, 2015, at A11 (noting proposal to increase NIH funding for cancer research by $9.3 billion).

279. NSF, NAT'L CTR. SCI. & ENG'R STATISTICS, FEDERAL FUNDS FOR RESEARCH AND DEVELOPMENT FYS 2012–14, tbl. 3, "Federal obligations for research, development, and R&D plant, by agency," https://www.nsf.gov/statistics/nsf14316/pdf/tab3.pdf.

c) "Dual Use" Funding

The federal government does fund private, commercial innovations. However, when the government funds such research, it requires the research to have "dual use": demonstrated commercial relevance *and* relevance to a core federal mission area like defense, health, or efficient energy use.[280] There are currently a variety of dual-use programs through which private companies can obtain funding so long as they are conducting research in a national mission area that suits an agency's needs—especially in the military context.[281]

A prominent example of a dual-use program is the Defense Advanced Research Projects Agency (DARPA), whose stated mission is "to make pivotal investments in breakthrough technologies for national security."[282] DARPA spends over $2 billion a year on projects such as advanced humanoid robots.[283] Another high-profile example is In-Q-Tel, the Central Intelligence Agency's venture capital arm that finances innovation related to CIA missions, and sometimes obtains equity stakes in the companies it funds.[284] The most general-purpose dual use program is the Small Business Innovation Research (SBIR) program, which is oriented toward helping small businesses while pursuing national mission goals.[285] SBIR's mandate requires all federal agencies spending over $100 million annually on extramural research contracts to reserve a portion of their budgets for contracts with for-profit small businesses with under 500 employees.[286]

280. *See* Branscomb & Parker, *supra* note 269, at 69; Kelley, *supra* note 269, at 315–26.

281. *See* Kelley, *supra* note 269, at 317–18 (discussing adoption of dual use programs during the Clinton era and suggesting a broader definition of "dual use" to incorporate non-military investments in mission areas with potential commercial relevance).

282. *See* DARPA, MISSION, http://www.darpa.mil/about-us/mission (last visited Feb. 7, 2017).

283. *See* DARPA, BUDGET, http://www.darpa.mil/about-us/budget (last visited Feb. 7, 2017); DARPA, OUR RESEARCH ARCHIVE, http://www.darpa.mil/archive/our-research (last visited Feb. 7, 2017).

284. *See* Keller, *supra* note 28, at 109–32 (discussing federal venture capital programs for firms developing technologies related to defense and national security); *see also* John Markoff, *Pentagon Shops in Silicon Valley for Game Changers*, N.Y. TIMES, Feb. 27, 2015, at A3 (discussing the Pentagon's announcement of a new venture financing program and noting that some companies see committing to do research by the military as problematic).

285. *See* Small Business Innovation Development Act of 1982, Pub. L. No. 97-219, 96 Stat. 217 (1982) (codified at 15 U.S.C. § 638 (2012)) (re-authorized through 2017 in the National Defense Authorization Act for Fiscal Year 2012, Pub. L. No. 112-81, § 5101, 125 Stat. 1298, 1824 (2011)); 15 U.S.C. § 638(e)(4) (defining SBIR program).

286. *See* 15 U.S.C. § 638 (f)(1) (listing required set-aside percentages, which increase each fiscal year through 2017).

Funded research must fall into agency mission areas. In practice, most awards go to companies working on technology related to defense and public health.[287]

In a recent influential book, Mariana Mazzucato argues that, contrary to common perception, the U.S. government directly finances innovation, and should do so more.[288] However, despite Mazzucato's characterization of the U.S. government as an "entrepreneurial state," the national government rarely departs from this "dual use mandate."[289] When it does, the federal government is accused of engaging in "industrial policy" and "picking winners."[290] An example is the Department of Commerce's short-lived venture capital program. For several years, NIST was authorized to operate the Advanced Technology Program (ATP), which provided open-ended equity financing for companies involved in commercializing high-risk research: "In essence, the mission of the . . . [ATP was] to support private sector R&D projects that offer[ed] potential for contributing to technical advance and for realizing economic value."[291] But the ATP was abolished in 2011 in the midst of wrangling over the national budget.[292] The ATP's demise is not an isolated incident. More recently, for instance, pundits

287. In 2012, most SBIR awards were granted through the DOD and the NIH. Small Bus. Innovation Research, *SBIR Annual Report*, SBIR, https://www.sbir.gov/awards/annual-reports (last visited Feb. 9, 2016).

288. *See* MARIANA MAZZUCATO, THE ENTREPRENEURIAL STATE: DEBUNKING PUBLIC VS. PRIVATE SECTOR MYTHS (2014); *see also* Eduardo Porter, *Public R&D, Private Profits and Us*, N.Y. TIMES, May 27, 2015, at B1, B7 (discussing Mazzucato's argument and raising concerns about government taking an equity stake in companies it funds).

289. Mazzucato's characterization of the U.S. government as an "entrepreneurial state" is somewhat misleading. In fact, the U.S. programs Mazzucato discusses in her book, such as DARPA and SBIR, are "dual use" programs: they support private sector research only in areas that are already in the research purview of federal mission agencies.

290. *See id.*; *see also* Lewis M. Branscomb, *The National Technology Policy Debate*, *in* EMPOWERING TECHNOLOGY: IMPLEMENTING A U.S. STRATEGY 8, 8–9, 14, 19 (Lewis M. Branscomb ed., 1993) (discussing objections to so-called "industrial policy" and "picking winners" in the context of U.S. technology policy).

291. Maryann P. Feldman & Maryellen Kelley, *Leveraging Research and Development: Assessing the Impact of the U.S. Advanced Technology Program*, 20 SMALL BUS. ECON. 153, 162 (2003); *see also* WENDY SCHACHT, CONG. RESEARCH SERV., 95-36, THE ADVANCED TECHNOLOGY PROGRAM (2007).

292. *See* WENDY H. SCHACHT, CONG. RESEARCH SERV., 95-30, THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY: AN APPROPRIATIONS OVERVIEW (2013) (summarizing the appropriations history of the ATP program). Note that in 2007 the name changed from the Advanced Technology Program to the Technology Innovation Program and some of the program's eligibility requirements shifted. *See id.* at 2.

criticized the federal government after it provided public financing to Solyndra, a solar company that failed.[293]

Lewis Branscomb, former director of NIST, describes this landscape as the U.S. government's "mission-justified" approach to technology policy. Under the mission-justified approach, the government avoids intervening in the private sector except where justified by a national mission and circumscribed by the goals and administrative capacity of a federal mission agency.[294] In other words, Branscomb interprets the mission-justified approach as a pro-market, anti-interventionist policy.

The internalization principle—that public goods should be supplied by the smallest jurisdiction that internalizes the benefits—provides a different explanation for the federal government's selective, mission-oriented innovation policy. It's not just about adherence to the free market; it's about adherence to federalism and the role of states and local governments in controlling innovation policy. As explained in Section II.C, innovation, and particularly innovation that engages the private sector, tends to result in significant localized benefits for the region in which it occurs. Thus, while the federal government can justify using national money to finance R&D in "national public goods" areas that provide countrywide benefits, justifying federal funding for research outside of these national mission areas is much harder. First, it may be unfair for residents of, say, North Carolina to fund commercial software research that California companies are mostly conducting.[295] Second, the efficiency arguments discussed in Section IV.C suggest that the national government should have stronger incentives and better information than local governments to fund research in areas where national agencies are already engaged. Absent federal funding, it is unlikely that states would fund research into, say, defense or public health of their own accord.

However, for general private sector innovation, the case is different. Here, the incentives are reversed: Congress's incentives to promote private sector innovation are highly diffuse, as economic benefits are spread about the country and highly concentrated in certain areas in the short term; but local governments' incentives to spend on private sector innovation are quite strong. This result is what one would expect from the collective action

293. Joe Stephens & Carol D. Leonnig, *Solyndra: Politics Infused Obama Energy Programs*, WASH. POST (Dec. 25, 2011), http://www.washingtonpost.com/solyndra-politics-infused-obama-energy-programs/2011/12/14/gIQA4HllHP_story.html.

294. *See* Branscomb, *supra* note 290, at 14, 19; *see also* BRANSCOMB & AUERSWALD, *supra* note 28, at 144 ("[F]ederal politics views with suspicion government programs to assist individual firms.").

295. As mentioned, however, this is a controversial argument. See discussion *supra* Section III.C.

federalism theory: the smallest jurisdiction that captures the benefits is the most likely to act to obtain them. While states cannot effectively protect exclusive rights in public information that easily spills over to other jurisdictions, they can—and do—use public finance to internalize many of the benefits of innovation. States accomplish this internalization through direct taxation. They also internalize the variety of benefits that result from having innovators located in the region: more skills and knowledge within the populace, more employment and business opportunities, more start-ups, and more commercialization and production activities. The next section discusses this phenomenon in detail.

*2. U.S. State Innovation Finance*

The federal government's "mission-oriented" approach to innovation finance stands in contrast to that of subnational governments such as states. As Branscomb and Philip Auerswald have observed, unlike the federal government, the states "are politically quite comfortable competing with one another to attract new business through active programs of R&D subsidies."[296] In this section, I assess these competing state R&D programs. Looking at programs from a wide selection of states, I show that, unlike federal innovation finance, state innovation finance can be available at all phases of development, including the commercialization stage, and is not limited to discrete technology areas—so long as the subject matter meets states' economic development objectives.

a) Origins

State governments' active efforts to promote innovation in their jurisdictions have deep roots in state economic development policy. The colonies and independent states granted "exclusive privileges" (the early term for patents and other exclusive rights) and a variety of other incentives, such as tax breaks and land grants, for companies and individuals to undertake high-cost development projects, such as iron mines and mills.[297] Following ratification of the Constitution, states continued to use public debt to stimulate growth within their borders. States built roads, canals and transportation systems, and used a variety of tax inducements to spur regional economic growth.[298] Indeed, throughout the nineteenth century,

296. BRANSCOMB & AUERSWALD, *supra* note 28, at 144.

297. On state and colonial patent practices, see Hrdy, *State Patent Laws in the Age of Laissez Faire*, *supra* note 25.

298. MICHAEL LIND, LAND OF PROMISE 53 (2013) ("In 1817, [Governor] Clinton persuaded the New York legislature to authorize $7 million to build the canal. Half of the bonds for the Erie Canal were purchased by foreigners.").

states, not the federal government, were the main drivers of economic development, using raised or borrowed money to finance transportation systems like canals and railroads.[299] Under the Morrill Act of 1862, Congress allocated the states land on which to establish colleges and "agricultural experiment stations" to conduct research adapted to local crops and environmental conditions.[300] Thereafter, states used their influence over universities to push applied research with practical implications for local economic development.[301]

In the past thirty years, states have increasingly emphasized science and technology policy and created a variety of programs to encourage academic research and research-intensive enterprise in their jurisdictions.[302] According to Dan Berglund and Chris Coburn, whose 1994 study of state cooperative technology programs was one of the first to bring this phenomenon to light, the main reason for states' growing interest was the increasing economic importance of knowledge-intensive industries as compared to manufacturing. By expanding their economic development policies to include support for research universities, corporate R&D, patent generators, and winners of federal grants, states sought to avoid the job and revenue losses that occur when manufacturing companies go bankrupt or leave.[303]

To achieve this end, several states in the 1980s established cooperative technology programs: "public-private initiatives involving government and industry—and often universities—that sponsor the development and use of technology and improved practices to measurably benefit specific

299. *See generally* Harry N. Scheiber, *State Law and "Industrial Policy" in American Development, 1790–1987*, 75 CALIF. L. REV. 415 (1987).

300. Under the Land-Grant Collect Act of 1862 (also known as the "Morrill Act"), Congress allocated federal land to each state to support development of a colleges focused on instruction of "agriculture and the mechanic arts." *See* 7 U.S.C. § 301 et seq. (2012). Under the 1887 Hatch Act, more land was given to the states for Agricultural Experiment Stations associated with land grant colleges. *See* 7 U.S.C. § 361a et seq. (2012); Tiffany Shih & Brian Wright, *Agricultural Innovation*, *in* ACCELERATING ENERGY INNOVATION: INSIGHTS FROM MULTIPLE SECTORS 55-57 (Rebecca M. Henderson & Richard G. Newell eds., 2011) (discussing the establishment of land grant colleges and state agricultural experiment stations in the United States); *see also* Fromer, *The Intellectual Property Clause's External Limitations*, *supra* note 25, at 1348–49, 1356 (noting that one of the reasons the Framers decided not to give Congress express authority power to establish universities was the perception that states could do so on their own).

301. *See* David Audstretch, *The Entrepreneurial Society and the Role of the University*, 32 ECONOMIA MARCHE J. APPLIED ECON. 7, 8 (2013); Peter Lee, *Patents and the University*, 63 DUKE L.J. 1, 8–10 (2013).

302. BERGLUND & COBURN, *supra* note 201, at 5–9.

303. *Id.*

companies" for the goal of economic growth.[304] Examples include Pennsylvania's Ben Franklin Partnership and Oklahoma's Center for Advancement of Science and Technology.[305] By the early 1990s, *all fifty states had such programs*.[306]

b) An Emphasis on Localized Benefits

After reviewing all the programs available as of 1994, Berglund and Coburn came to the conclusion that state innovation programs are fundamentally different from federal innovation programs because they seek *localized* benefits. A "key criterion" for states, they write, is "the degree to which the projected benefits can be captured in the target region."[307] Specifically, as others have noted, states hope to obtain "gains in employment; diversification of the regional economy; the influx and retention of a highly educated labor force; an expansion of the tax base; and growth in related service industries."[308] So "[w]hile state-sponsored programs may have benefits beyond their borders, states are aggressive about ensuring that they capture an appropriate share within their borders," which is "reflected in the types and stages of research and technology investments states make."[309] As a result, "[t]his orientation drives states toward industrially related technology fields where new products and processes can be readily deployed by companies resident in the state."[310]

For example, when Connecticut established Connecticut Innovations in 1989[311] to invest in local start-ups, the legislature explicitly based its decision to spend such large sums of public money on the finding "that the creation of new technology-based businesses represents an important source

304. *Id.* at 1.
305. *Id.* at 8–9.
306. *Id.* at 9.
307. *Id.* at 15.
308. Terrance McGuire, Note, *A Blueprint for Disaster? State Sponsored Venture Capital Funds for High Technology Ventures*, HARV. J.L. & TECH. 419, 419 (1994); *see also* Bo Zhao & Rosemarie Ham Ziedonis, *State Governments as Financiers of Technology Startups: Implications for Firm Performance*, at 5 (July 2012) (unpublished manuscript), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2060739 (observing that in financing innovation "state governments pursue more parochial interests: to stimulate economic growth inside geographic borders and to diversify the tax base"); BERGLUND & COBURN, *supra* note 201, at 5–9 (discussing the origin of state technology initiatives and noting that these initiatives were closely linked to states' long-standing interest in promoting economic development).
309. BERGLUND & COBURN, *supra* note 201, at 15.
310. *Id.*
311. *See* "Innovation Capital Act of 1989," codified at CONN. GEN. STAT. ANN. § 32-32 et seq. (West 2010 & Supp. 2014).

of new jobs for the economy of the state, that it is essential for existing businesses and industry to innovate and adopt new state-of-the-art processes and technologies in order for such business and industry to expand, to create and retain employment and to better compete in the global marketplace."[312]

On the flip side, states are unlikely to support non-commercial innovations or basic research with little current commercial relevance "because its results are so easily diffused before any special benefit can be gained."[313] Instead, states would be more likely to focus on research with near-term commercial relevance for local companies.[314] States hope any benefits resulting from this research will "stick to the ribs" of local firms for as long as possible rather than spilling over to other firms outside the state.[315] In addition to the threat of knowledge spillover, states are also motivated by the threat of "brain-drain": the departure of the region's most highly skilled people.[316]

c) Categories of State Innovation Finance

Today all states and many cities make promoting innovation a core feature of their economic development policies. Local innovation strategies vary widely and are constantly evolving. Five categories of state innovation finance exist: (1) research incentives, (2) commercialization incentives, (3) R&D tax incentives and subsidies, (4) education and worker training programs, and (5) investments in infrastructure. Each state finance category has a similar two-fold goal: to promote investment in innovation, i.e. doing things that are new to some unit of adoption and that have "value" in some

312. CONN. GEN. STAT. ANN. § 32-33. The state was particularly concerned about Connecticut's overreliance on defense contracts with the federal government. *See id.* ("It is further found and declared that Connecticut ranks very high among the states on a per capita basis in the amount of prime defense contracts awarded; that the economies of many areas in the state and the employment opportunities offered by many businesses in the state are heavily defense-dependent and would suffer severe adverse impacts in the event of prime defense contract cutbacks . . . .").

313. BERGLUND & COBURN, *supra* note 201, at 15.

314. *See id.* Of course, as Berglund and Coburn note, the federal government also seeks to capture benefits from its investments in the United States. This "federal approach is reflected in program selection criteria." *Id.* For instance, federal selection criteria may include the requirement that research have relevance for a national mission such as defense. This is called a "dual-use" technology, as explained above. *See supra* Section V.B.1.c.

315. *See* Louis G. Tornatsky, *Building State Economies by Promoting University-Industry Technology Transfer*, at 10 (2000), http://www.gbcbiotech.com/transferencia-tecnologia/assets/building-state-economies-by-promoting-university-industry-technology-transfer.pdf (published by the Nat'l Governors Ass'n Ctr. for Best Practices).

316. *See id.* at 10 ("There is evidence of a considerable imbalance in the across states in the interstate migration of highly skilled people, commonly referred to as the 'brain drain.'").

commercial market,[317] and to achieve the localized benefits just mentioned: employment opportunities for residents, attracting a skilled workforce, diversification of the economy and the tax base, and growth in related industries like construction, specialized suppliers, and restaurants.

i) Research Incentives

As discussed, basic research funding is mostly federal and states are unlikely to spend large amounts of public money on basic research with little near-term commercial relevance. But states have nonetheless taken on an increasing share of the responsibility for funding science and technology-based research. Based on years of research studying states' growing engagement in science and technology policy, Maryann Feldman has concluded that the states' growing role in the "basic research enterprise" suggests that "public support for R&D no longer rests solely at the federal level."[318]

In recent research, Feldman and Lauren Lanahan report that since 1980 states' expenditures on university R&D programs have increased threefold to $3.13 billion, which accounts for 5.8% of all university research and is more funding than industry supplies for academic R&D.[319] Building on Berglund and Coburn's 1994 survey of state technology programs, Feldman and Lanahan document several trends in "state science policy experiments."[320]

They identify three types of common state programs that support basic and applied research at universities. Each of these programs appear to be explained by states' interests in capturing the benefits of research and commercialization within their borders.[321] In addition, the chance for capturing federal grant money is also a driving factor. Maybe this is

317. See definition of innovation *supra* Section II.A.

318. Feldman & Lanahan, *supra* note 29, at 287. For empirical work on state financing for innovation, see, for example, Maryann Feldman & Lauren Lanahan, *Silos of Small Beer – A Case Study of the Efficacy of Federal Innovation Programs in a Key Midwest Regional Economy*, CTR. FOR AM. PROGRESS, at 3–4 (Sept. 2010), https://www.americanprogress.org/wp-content/uploads/issues/2010/09/pdf/small_beer_exec_summary.pdf (finding that state awards were perceived to be more accessible than federal awards); Zhao & Ziedonis, *supra* note 308, at 2–3 (concluding Michigan's technology financing grants enhanced company survival as compared to similar prospects that did not get award).

319. Feldman & Lanahan, *supra* note 29, at 287.

320. *Id.* at 288.

321. *Id.* at 287–88 (asserting that states invest in science as a means to "facilitate commercialization" and "capture returns within their borders" and to "increase their share of federal R&D expenditures").

cooperative federalism in action: states are paying for the local benefits, and the federal government is picking up the bill for out-of-state spillovers.[322]

**1. Recruitment Incentives for Faculty and "Star Scientists."** The first program, which Feldman and Lanahan call eminent scholars programs, creates recruitment incentives for prolific "star scientists" with strong records in obtaining grants and patents. Grants are usually $3-6 million per scholar, and as of 2009, 21 states have adopted eminent scholars programs.[323] For example, Arizona has an "eminent scholars matching grant fund" that allocates some of the state's annual income towards matching funds "to attract and retain eminent faculty." The funds provide a certain amount of matching for "nonpublic endowment monies donated [to the universities] to attract and retain eminent faculty."[324] The idea behind these programs is to invest in the people who generate basic research and who win federal funding and patents, rather than the research itself. In other words, they have the goal of producing human capital externalities, to use Moretti's term, rather than simply producing new technical knowledge.

**2. Grants for Research.** The second common state incentive for academic research, adopted in 29 states as of 2009, is university research grants programs. These programs create state-sponsored grants for basic and/or applied research, available to all researchers at universities or research institutions in the state, without requiring prior federal funding or other non-state matching.[325] According to Berglund and Coburn, who noted the emergence of state basic and applied research grants programs in the 1980s, the purpose of state basic research grants is to help scientists who were "on the verge of becoming nationally competitive in receiving funding" by providing them grants early in their careers. Additionally, the state basic research grants create "a track record that will help them to compete for federal monies, thereby bringing more research funds to the state."[326] Grants for applied research, meanwhile, are "deigned to help scientists become active in applied research and to encourage partnerships

322. See discussion of matching grants to compensate for externalities *supra* Section IV.D.1.

323. Feldman & Lanahan, *supra* note 29, at 290.

324. ARIZ. REV. STAT. § 15-1663.B (LexisNexis 2015).

325. *See, e.g., id*.

326. BERGLUND & COBURN, *supra* note 201, at 84 (discussed in Feldman & Lanahan, *supra* note 29, at 291).

with industry, which, in turn, will benefit from the new technology that creates and retains jobs."[327]

**3. Centers to Increase University-Industry Cooperation.** The third program identified by Feldman and Lanahan is the "Center for Excellence"—university-based centers with a focus on promoting collaboration between universities and industry and on encouraging faculty to undertake research oriented towards the needs of specific industries or technologies.[328] For instance, Massachusetts created the Massachusetts Centers of Excellence Corporation (now the Biotechnology Center of Excellence Corporation (BCEC)) in 1985 to "facilitate technology transfer and commercialization of emerging technologies through university/industry collaboration."[329] According to Feldman and Lanahan, this type of program is the most common, adopted by 28 states, and also the first type of program that states adopted.[330] Their explanation is that, generally speaking, the states are more comfortable "[prioritizing] making investments in academic research *directly linked to industrial activity over supporting more upstream efforts*."[331]

ii) Local Commercialization Incentives

The theme that emerges from state investments in basic and academic research is that states are driven not only by the desire to correct market failures in research, but also by the desire to "stimulate economic growth inside geographic borders."[332] Thus, it should not be surprising that state actions in innovation finance become far more visible, and far more expensive, when we look at incentives whose express purpose is to resolve market failures in *commercialization* of inventions, rather simply to generate new knowledge.[333] This section describes several kinds of commercialization incentives offered by states and sometimes cities. The main division between local commercialization incentives is whether they

327. *Id.*; *see also* Ark. Econ. Dev. Comm. Science & Tech., About Commercialization: Technology Transfer Assistance Grant Program (TTAG), http://www.asta.arkansas.gov/ttag.html (2015).

328. Feldman & Lanahan, *supra* note 29, at 292.

329. *See* BIOTECH. CTR. EXCELLENCE CORP., http://home.mindspring.com/~bcec/ (last visited Feb. 9, 2016).

330. Feldman & Lanahan, *supra* note 29, at 292.

331. *Id.* (emphasis added).

332. *See* Zhao & Ziedonis, *supra* note 308, at 5 (discussing various reasons Michigan likely began supplying financing for local technology companies, including both correcting market failures and improving the regional economy).

333. *See* Hrdy, *Commercialization Awards*, *supra* note 5, at 21.

are directed at the university interface or at purely private enterprises such as new start-ups seeking financing.

**1. Technology Transfer Offices.** States' involvement in technology transfer at the university interface illustrates concerted effort to push academic research to market: the transformation of academic research into commercial products, services, or other applications.[334] Universities usually have technology transfer offices (TTOs) that assist university faculty in patenting their inventions and then sell or license those patents to private sector firms. Patent and other IP often (though not necessarily) mediate technology transfer based on the theory that, if the underlying research can be protected, this protection will make private companies more likely to invest in its commercialization.[335] Ostensibly, TTOs aim to ensure that university-generated research is put into use "for the broader benefit of society." But in practice, TTOs may be more focused on generating revenues for the university than on ensuring university research is commercialized or creates tangible benefits for the community.[336]

Besides the university and society at large, technology transfer offices can benefit the local economy as a result of the licensing activity that occurs in and around universities and government labs. Not only can local governments collect taxes on profits, sales, payrolls, and property from universities and licensee corporations, they can also expect benefits from spillover to local businesses in non-innovation sectors, especially through employment.[337] For instance, in 2014, the University of California system reportedly obtained 496 patents, disclosed 1796 inventions, and produced 86 start-ups (faculty "spin-outs"). These in turn generated $14 billion in revenue for the university (most of which goes back into university

334. Arti Rai & Rebecca Eisenberg, *Bayh-Dole Reform and the Progress of Biomedicine*, 66 L. & CONTEMPORARY PROBLEMS 289 (2003).

335. *But see* Eisenberg, *Limiting the Role of Patents in Technology Transfer*, 37 L. QUAD. NOTES 40, 40–43 (1994) (adapted from remarks presented to the Congressional Biomedical Research Caucus in Washington, D.C., on June 28, 1993) (questioning the wisdom of allowing patents on government-sponsored research to promote technology transfer and suggesting that costs of patenting government research may outweigh the benefits).

336. *See* Jay Kesan, *Transferring Innovation*, 77 FORDHAM L. REV. 2169, 2169 (2009) (arguing that university technology transfer activities are "predominantly patent-centric and revenue-driven with a single-minded focus on generating licensing income and obtaining reimbursement for legal expenses"); *see also* Liza Vertinsky, 4 UTAH L. REV. 1949, 1949 (2012) (arguing that "if universities obtained more discretion, responsibility, and accountability over the post-discovery development paths for their inventions, they might be able to improve the trajectory for many promising scientific discoveries").

337. MORETTI, *supra* note 40, at 73–120 (discussing the variety of tax and labor benefits that accrue in those regions that succeed in developing innovation clusters).

operations) and led to the employment of around 19,000 people in the area.[338] Many doubt whether universities generate enough revenues to cover their costs in technology transfer.[339] But whether the benefits to the local economy justify the costs is more difficult to measure or to dispute.[340]

**2. Venture Financing – University Spin Outs.** Along with TTOs, some universities also provide venture financing to university faculty and students seeking starting their own companies outside the university, called spin-outs. For example, the University of California is preparing to launch "UC Ventures," an independent $250 million fund to pursue investments in enterprises fueled by UC research. According to proponents like UC President Janet Napolitano, UC Ventures will spur technology commercialization efforts already underway at UC schools and will help faculty and students "develop innovations that can benefit California and the world."[341]

**3. Venture Financing – Private Enterprises.** State commercialization initiatives are not limited to the university interface. Recently states, and even some cities, have begun funding their own venture capital units to supply *private enterprises* with financing for commercializing inventions and testing out new business models.[342] State venture capital has two purposes: generating revenues and boosting local economic development though spillovers. When states obtain equity stakes in the companies they fund, they can theoretically achieve a good return on investment and generate profits for the state.[343] However, as Terrance P. McGuire has observed, this goal of achieving a high return on the investment may conflict

338. UC Office of the President Press Release, Technology Commercialization Report (FY 2014), at 16, http://www.ucop.edu/innovation-alliances-services/innovation/innovation-impact/technology-commercialization-report.html.

339. *See, e.g.*, Walter Valdivia, *University Start-Ups: Critical for Improving Technology Transfer*, BROOKINGS INST. CTR. FOR TECH. INNOVATION, at 1 (Nov. 2013), https://www.brookings.edu/research/university-start-ups-critical-for-improving-technology-transfer/.

340. *See, e.g.*, Maryann P. Feldman & Pierre Desrochers, *Research Universities and Local Economic Development: Lessons from the History of the Johns Hopkins University*, 10 INDUS. & INNOVATION 5 (2003).

341. UC Office of the President, University of California Proposes Creation of New Venture Fund to Invest in UC Innovation, UNIV. OF CAL. (Sept. 15, 2014), http://www.universityofcalifornia.edu/press-room/university-california-proposes-creation-new-venture-fund-invest-uc-innovation.

342. Hrdy, *Commercialization Awards*, *supra* note 5, at 54–56.

343. *See* Terrance McGuire, *supra* note 308, at 435.

with the goal of promoting local economic development.[344] For example, if a state decides to focus on the highest-profit investments, it might fund companies that hire few local workers or that do not intend to remain in the state for a long period. Alternatively, a state more concerned about promoting local development should fund a company with a solid base in the local economy that is likely to remain, hire local employees, and generate positive externalities for other companies in the area that benefit from the same suppliers and labor markets.

iii) Business Tax Incentives and Subsidies

As is now clear, states' interest in science and technology policy extends outside the walls of the university. The best examples are state subsidies and tax incentives for research firms that agree to locate in the state. In pursuit of the economic benefits of research-intensive industries, states and cities spend billions of dollars every year on tax incentives and subsidies to attract businesses, usually qualifying such incentives on the requirement that recipients perform qualifying research and development in the state.[345] As Walter Hellerstein and Dan Coenen have discussed, these subsidies serve as an "inducement to local industrial development and expansion."[346]

As of 2010, 34 states offer general R&D tax credits.[347] Most state R&D tax credits mirror all or some aspects of the federal R&D credit.[348] Under the federal R&D tax credit, contained in Section 41 of the U.S. Internal Revenue Code, businesses can obtain a tax credit based on qualifying research expenses so long as they are (1) undertaken for purposes that are "technological in nature," (2) intended to yield applications "useful in the development of a new or improved business component," and (3) comprise activities "substantially all . . . of which constitute elements of a process of

344. *Id.* ("[T]he fundamental question that confronts all state planners [starting a public venture fund] is whether the fund should focus on return on investment (ROI) or economically targeted investments (ETI).").

345. For a survey of state R&D tax incentives, see MICHAEL D. RASHKIN, RESEARCH AND DEVELOPMENT TAX INCENTIVES: FEDERAL, STATE, AND FOREIGN 1–2 (2007). *See also* Legislative Budget Board, State of Texas, Overview of Research and Development Tax Incentives 14–23 (2013) (surveying business ad sales tax incentives in all fifty states).

346. Walter Hellerstein & Dan Coenen, *Commerce Clause Restraints on State Business Development Incentives,* 81 CORNELL L. REV. 789, 790 (1996).

347. For a state-by-state survey, see RASHKIN, *supra* note 345. *See also* Moretti & Wilson, *supra* note 87, at 3.

348. *See* RASHKIN, *supra* note 345, at 265 (noting that most state research credits are based on the federal credit albeit with significant variations from state to state); *see also* Ruth Mason, *Delegating Up: State Conformity with the Federal Tax Base*, 62 DUKE L.J. 1267, 1274–79 (discussing states' tendency to conform their tax laws to the federal government's).

experimentation."[349] Along with offering a state-level version of this basic R&D credit, some states provide additional tax incentives that are not currently available at the federal level, such as refundable credits for start-ups and early-stage companies that have no profits yet and cannot benefit from the federal credit.[350] State start-up credits have spurred calls for a similar federal credit.[351]

iv) Education and Worker Training

The largest state innovation finance expenditure is state funding for education.[352] In recent years, states have become increasingly motivated to support Science, Technology, Engineering, and Math (STEM) education. As Jonathan Rothwell writes in a recent Brookings Institute report on STEM education, "state and local governments affect STEM education through many channels. They boost university and community college STEM education through funding and scholarships. They support training by coordinating workforce development efforts, and they shape K-12 STEM education by approving and funding of STEM-focused schools; the training, certification, and management of teachers; and the development and enforcement of content standards."[353]

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349. I.R.C. § 41(d)(1) (2012).

350. Several states offer refundable R&D tax credits. For example, Louisiana offers an R&D tax credit that can be carried forward for up to five years. LA. STAT. ANN. § 47:6015(K) (West 2016) ("If the amount of the [R&D credit authorized under this Section] exceeds the amount of tax liability for the tax year, the excess credit may be carried forward as a credit against subsequent Louisiana income or corporation franchise tax liability for a period not to exceed five years."). For more examples of refundable state R&D tax incentives, see Joe Stoddard, *States Battle for R&D Investment by Enhancing Tax Incentives*, THE TAX ADVISER (Jan. 31, 2012), http://www.thetaxadviser.com/issues/2012/feb/clinic-story-10.html.

351. *See* Sen. Chris Coons & Sen. Mike Enzi, *R&D Tax Credit Spurs Innovation*, POLITICO (Mar. 7, 2013), http://www.politico.com/story/2013/03/rd-tax-credit-spurs-innovation-088525 (calling for support for the Startup Innovation Credit Act, S. 193, 113th Cong. (2013)).

352. In 2012, local education agencies in the 50 states and the District of Columbia reported $603.5 billion in total revenues on education. Of those revenues, only $60.7 billion (10.1%) came from the federal government. $272.4 billion (45.1%) came from state governments, and $270.4 billion (44.8%) came from local government. U.S. DEP'T OF EDUC.: NAT'L CTR. EDUC. STATISTICS, REVENUES AND EXPENDITURES FOR PUBLIC ELEMENTARY AND SECONDARY SCHOOL DISTRICTS: SCHOOL YEAR 2011–12 (FISCAL YEAR 2012), at 4, tbl. 1, "Sources of revenues and type of expenditures for public elementary and secondary education, by state or jurisdiction: Fiscal year 2012," https://nces.ed.gov/pubs2014/2014301.pdf.

353. Jonathan Rothwell, *The Hidden STEM Economy*, BROOKINGS INST. METRO. POL'Y PROGRAM (June 2013), at 20–21, http://www.brookings.edu/~/media/research/files/reports/2013/06/10-stem-economy-rothwell/thehiddenstemeconomy610.pdf; *see also*

Examples of state programs focused on STEM education include: Illinois' "STEM Learning Exchanges," which establish contracts for regional, educational and business networks to assess educational needs and confront challenges for STEM education;[354] North Carolina's "Education Enhancement Grants" for non-profit institutions that develop programs to enhance biotechnology education and workforce training;[355] and Georgia's Educational Technology Consortium, which operates several programs to improve students' access to technology and development of skills useful in high tech jobs.[356]

Why are states funding these programs? Economic federalism theory suggests an explanation. Perhaps, like knowledge itself, education in knowledge-intensive fields behaves like a "local public good": a resource that primarily benefits a particular geographic region, and that may be best supplied at a "very local level."[357] Even though STEM education can obviously produce significant national spillovers when people share knowledge across state borders or move to work in other states, the beneficiaries of these programs may well decide to reside in the region and become employed by local firms. In other words, local policymakers have a strong incentive to supply STEM education because they believe they can internalize the benefits. At the same time, the pressure to compete with other states creates an additional incentive to support STEM education: to avoid flight.

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STATE SCI. & TECH. INST., TRENDS IN TECHNOLOGY-BASED ECONOMIC DEVELOPMENT: LOCAL, STATE AND FEDERAL ACTION IN 2012, at 10–12 (2012), http://ssti.org/sites/default/files/trends2012.pdf (discussing recent STEM initiatives offered by states and cities); Aaron Chatterji, Edward Glaeser, & William Kerr, *Clusters of Entrepreneurship and Innovation*, 14 INNOVATION POL'Y & ECON. 129, 152 (2014) ("At the state level, 18 states have passed some legislation as of 2007 to encourage entrepreneurship education, with significant variance in terms of requirements and curriculum.").

354. *See* 105 ILL. COMP. STAT. 5/26-17(3) (2015); ILL. PATHWAYS, *STEM Learning Exchanges*, https://www.illinoisworknet.com/ilpathways/Pages/STEMLE.aspx (last visited Feb. 2, 2017).

355. *See* N.C. BIOTECH. CTR., EDUCATION ENHANCEMENT GRANT PROGRAM, http://www.ncbiotech.org/workforce-education/education-funding/education-enhancement-grant (last visited Feb. 9, 2016); *see also* N.C. BIOTECH. CTR., EDUCATION ENHANCEMENT GRANTS: FULL PROPOSAL GUIDELINES AND INSTRUCTIONS (June 21, 2013), http://www.ncbiotech.org/sites/default/files/funding/2013-2014%20EEG%20FP%20Guidelines%20and%20InstructionsFinal.pdf.

356. GA. EDUC. TECH. CONSORTIUM, INC., INNOVATION GRANT WINNERS 2014, http://www.gaetc.org/domain/133 (last visited Feb. 9, 2016).

357. *See* MUELLER, *supra* note 151, at 81 (stating that schooling is a public good that is typically or at least feasibly could be provided "at a very local level").

v) Infrastructure and Public Services

States and cities finance the lion's share of physical infrastructure and public services, such as bridges, roads, and parks. These physical infrastructure and public services are classic examples of a "local public good" that suffers from congestion and is more efficiently provisioned at the local level.[358] In undeveloped countries, basic infrastructure is an obvious component of any policy for promoting economic development and innovation.[359] In the United States, where basic infrastructure is a given, states and cities can still influence levels of innovation in the region by tailoring their infrastructure to entrepreneurs and high-innovation sectors.

States have long supported university facilities like lab space.[360] Another example of physical infrastructure is the science or research "park": a formally planned cluster of innovative businesses and institutions, typically centered around one or more universities or national labs.[361] Famous research parks include Research Triangle Park in Raleigh-Durham, North Carolina, the largest research park in the world.[362] Research parks also come in smaller sizes and are called different names without changing the fundamental idea behind them: to bring companies and researchers together in one place. For instance, "as part of its long-term economic development focus," Davis, CA is building several new "innovation centers": "clusters of technology companies located together to create a kind of critical mass for new ideas and new products."[363] The city hopes that, although the centers may take "years to build out," it will "eventually

358. In 2007, local governments spent $145 billion (6% of revenues) on highways, new roads, and maintenance, and $955 billion on other public services, such as libraries, police, garbage removal, fire protection, park maintenance, snow removal, etc. EXEC. OFFICE OF THE PRESIDENT, ECONOMIC REPORT OF THE PRESIDENT, 2010-431 (2010), tbl. B-86, "State and local government revenues and expenditures, selected fiscal years, 1942–2007"; *see also* MUELLER, *supra* note 151, at 81–82.

359. *See generally* ROBERT D. COOTER & HANS-BERND SCHÄFER, SOLOMON'S KNOT: HOW LAW CAN END THE POVERTY OF NATIONS (2012).

360. NAT'L SCI. BD., SCIENCE AND ENGINEERING INDICATORS 2014, CHAPTER FIVE: ACADEMIC RESEARCH AND DEVELOPMENT 10–14 (2012) (reporting that state and local governments spend around $3 billion on university facilities and research and various R&D programs, which is more than is provided by industry).

361. BRUCE KATZ & JENNIFER BRADLEY, THE METROPOLITAN REVOLUTION 113–14 (2013) (discussing the prominent role of cities in cluster strategies).

362. *See* RESEARCH TRIANGLE PARK, WHO WE ARE, http://www.rtp.org/about-us/ (last visited Feb. 9, 2017).

363. Dave Ryan, *City Hires New Chief Innovation Officer*, THE DAVIS ENTER., May 31, 2015, at A1.

bring in large amounts of property and sales taxes, as well as high-paying jobs."[364]

Outside the university, cities provide public services that can make or break the successful development of a new technology or innovative business plan. A high-profile example is city provisioning of broadband and high-speed Internet to encourage entrepreneurship in the region.[365] Dozens of cities across the country are setting up municipal broadband networks.[366] Since broadband, lab space, and research parks all involve a physical location, it is not controversial to suggest local governments should at least partly finance them.[367] To the extent that these programs create national knowledge spillovers, the federal government should match funds. Broadband is an example of a technology that, despite its linkage to local infrastructure, could easily lead to uncontrollable knowledge spillovers and warrant federal sponsorship. For example, the White House's new initiative, BroadbandUSA, operated through the Department of Commerce, will promote broadband deployment and adoption in undersupplied cities around the country using federal funds allocated in the American Recovery and Reinvestment Act of 2009.[368]

## VI. CONCLUSION

In light of widespread dissatisfaction with IP rights, many claim innovation finance should supplant IP. The federal government, they argue, should supply this financing. But this conflicts with what currently happens. In the United States, patent law is federal; yet outside select research areas—primarily defense—funding for private sector innovation frequently comes from states and other subnational governments. For better or worse, U.S. innovation policy operates at both the federal and state level. This situation can be explained, and arguably justified, based on principles of economic federalism, under which innovation finance should be supplied

364. *Id.*

365. *See* Susan Crawford, *How Cities Can Take on Big Cable*, BLOOMBERG VIEW (June 27, 2014), http://www.bloombergview.com/articles/2014-06-27/how-cities-can-take-on-big-cable; Susan Crawford, *The Wire Next Time*, N.Y. TIMES, Apr. 28, 2014, at A21.

366. *See* Steve Lohr, *Lack of Choice Led to Push for Net Neutrality,* N.Y. TIMES, Feb. 26, 2015, at B1, B4.

367. *See* COOTER, *supra* note 16, at 105; *see also* Olivier Sylvain, *Broadband Localism*, 73 OHIO ST. L.J. 795 (2012) ("[L]ocal governments are supplying broadband service to residents to fill the service gap left by major providers.").

368. Press Release, The White House, FACT SHEET: Broadband that Works: Promoting Competition & Local Choice in Next-Generation Connectivity (Jan. 13, 2015), https://www.whitehouse.gov/the-press-office/2015/01/13/fact-sheet-broadband-works-promoting-competition-local-choice-next-gener.

by the smallest level of government that internalizes the benefits of its efforts. While subnational governments cannot realistically internalize the benefits of patent regimes that result in widespread diffusion of new information, they can internalize meaningful benefits from innovation by strategically financing it.

This conclusion has several major implications. First, if direct financing for innovation is chosen in favor of patent rights, a powerful beat of localism may be inevitable. Given that local governments can directly internalize many of the economic benefits of innovation finance, they are likely to have exceptionally strong incentives to subsidize private-sector innovations that are expected to benefit local firms and residents.

Second, economics—and specifically the economic theory of federalism—suggests that this division of authority represents a more optimal allocation of responsibilities between state and federal governments.[369] *Precisely because* their residents are the ones who directly benefit, local governments should have better incentives, and also better information, to design and fund innovation incentives that will work for the region. In addition, inter-jurisdictional competition to attract mobile participants in innovation industries—high-tech firms, skilled talent, and related firms and institutions—should push local policymakers to craft policies that are more effective than their neighbors', and lead to more precise clustering of firms and talent to appropriate locations.[370] Thus, if we really care about "growing innovation clusters for American prosperity," we must care about state and local governments.[371]

Lastly, the Article highlights that local governments' role in innovation finance has significant limits. The major limitation highlighted by the economic federalism literature is lingering externalities: obviously, national funding for knowledge with widespread social value is still necessary in cases where states cannot internalize sufficient economic benefits to justify funding it. In addition, as shown in Part II, geographic inequality among different regions in the U.S. may *already* be so severe that redistribution of benefits from rich to poor locations may be warranted—otherwise these regions will not realistically be able to compete in the "cluster competition" in the first place. Although economic federalism does not typically care about such arguments, I argue that geographic inequality too creates a strong argument for national intervention.[372]

369. *C.f.* Posner, *supra* note 144, at 41; *see also supra* Part IV.
370. *C.f.* COOTER, *supra* note 14, at 106, 129–30.
371. WESSNER, *supra* note 2.
372. *See* Hrdy, *Cluster Competition*, *supra* note 185.