2019

Innovation Policy Pluralism

Daniel Hemel

Lisa Larrimore Ouellette

THE YALE LAW JOURNAL

DANIEL J. HEMEL & LISA LARRIMORE OUELLETTE

Innovation Policy Pluralism

ABSTRACT. When lawyers and scholars speak of "intellectual property," they are generally referring to a combination of two distinct elements: an *innovation incentive* that promises a market-based reward to producers of knowledge goods, and an *allocation mechanism* that makes access to knowledge goods conditional upon payment of a proprietary price. Distinguishing these two elements clarifies ongoing debates about intellectual property and opens up new possibilities for innovation policy. Once intellectual property is disaggregated into its core components, each element can be combined synergistically with non-IP innovation incentives such as prizes, tax preferences, and direct spending on grants and government research, or with non-IP allocation mechanisms that promote broader access to knowledge goods.

In this Article, we build a novel conceptual framework for analyzing combinations of IP and non-IP policy mechanisms and present a new vocabulary to characterize those combinations. *Matching* involves the pairing of an IP incentive with a non-IP allocation mechanism—or, vice versa, the pairing of a non-IP incentive with IP as an allocation strategy. *Mixing* entails the use of IP and non-IP tools on the same side of the incentive/allocation divide: i.e., the use of both IP and non-IP innovation incentives, or of IP and non-IP allocation mechanisms. *Layering* refers to the use of different policies at different jurisdictional levels, such as using non-IP innovation incentives and allocation mechanisms at the domestic level within an international legal system oriented around IP. After setting forth this framework, we identify reasons why different combinations of IP and non-IP tools may be optimal in specific circumstances.

Our project is not merely theoretical: we argue that "pluralism"—the combination of IP and non-IP policies—provides a more descriptively accurate account of the innovation policy landscape than those that dominate the existing literature. Governments routinely, though often unwittingly, incorporate strategies of matching, mixing, and layering into their innovation policies. Even in the pharmaceutical industry—a sector sometimes described as the poster child for the pure IP patent system—the United States and other countries rely on complex combinations of IP and non-IP elements at the domestic level, all layered within an international IP system that apportions the costs of knowledge production across countries. Dissecting and reassembling the elements of this knowledge-production system reveals a richer menu of possibilities for IP reform, with potential applications to property law more broadly.

AUTHORS. Daniel J. Hemel is an Assistant Professor of Law at the University of Chicago. Lisa Larrimore Ouellette is an Associate Professor of Law and Justin M. Roach, Jr. Faculty Scholar at Stanford University. For helpful comments on earlier drafts, we thank Ian Ayres, Brian Baran, Stefan Bechtold, Anthony Casey, Tun-Jen Chiang, Kevin Collins, Terry Fisher, John Golden, David Hasen, Amy Kapczynski, Mark Lemley, Zachary Liscow, Jonathan Masur, Michelle Mello, Alison Morantz, Randy Picker, Eric Posner, Nicholson Price, Amy Proctor, Steve Shavell, Ted Sichelman, Henry Smith, Lior Strahilevitz, Rebecca Tushnet, David Weisbach, and participants in the 2016 IP Scholars Conference at Stanford Law School, the University of Chicago Law School Work-in-Progress Workshop, the George Washington Law School Faculty Workshop, the ETH Zurich Lecture Series on the Law & Economics of Innovation, the *Yale Law Journal* Contemporary Scholarship Workshop, and the Harvard Law and Economics Seminar.

ARTICLE CONTENTS

INTRODUCTION

What is intellectual property (IP)? From the innovator's perspective, it is a set of rules that rewards producers of knowledge goods with temporary exclusive rights to their creations. From the consumer's perspective, it is a set of rules that makes access to knowledge goods conditional upon the payment of a price above the marginal cost of those goods. Both characterizations are accurate. But they describe two very different elements of intellectual property. Contrary to the conventional characterization of IP as monolithic, these elements need not travel together.

Imagine, for example, a world in which producers of knowledge goods are rewarded with patents, but the government then buys those IP rights from producers for fair market value and makes access to knowledge goods free. From the innovator's perspective, this system still looks a lot like intellectual property, as the innovator receives a market-based reward at the end of the creative process. From the consumer's perspective, however, this world could not look any more different from IP—rather than paying a proprietary price for access to knowledge goods, the consumer can gain access at no cost.

Now imagine an alternative world in which knowledge goods are produced in government laboratories by public employees, but the government then claims a patent on the resulting knowledge goods and behaves like a monopolist in the market. From the perspective of the innovator (the government employee), this world looks nothing like IP: she is paid a fixed salary regardless of her output, and her laboratory's funding does not depend on the success of her projects or on market assessments of their value. From the perspective of the consumer, however, this world looks almost exactly like IP. The only difference is that the entity to which the consumer pays a proprietary price is the government rather than a private firm.

The point can also be made in more general terms. From the perspective of the inventor or creator, IP is an *innovation incentive*—it establishes the payoff structure for producers of knowledge goods. From the perspective of consumers, including both end users and those who use knowledge goods as an input to subsequent creation, IP is an *allocation mechanism*—it establishes the terms under which individuals and firms can gain access to knowledge goods. But these are not simply two different perspectives on the same policy. IP's innovation incentive and its allocation mechanism are distinct.

Distinguishing between IP as an innovation incentive and IP as an allocation mechanism clarifies ongoing debates in innovation law and policy. Consider the claim that IP's monetary payoffs "crowd out" other motivations that might lead researchers to pursue the projects with the highest social value, such as basic research efforts that lack immediate commercial applications.[1] This is a criticism of IP as an innovation incentive, not a criticism of it as an allocation mechanism. We can imagine a scenario in which government researchers receive a fixed salary regardless of which projects they pursue—thus reducing their vulnerability to the "crowding out" effect of IP—while the government still claims patents on the resulting inventions and behaves like a monopolist in the product market. Alternatively, consider the argument that IP leads to allocative inefficiencies because monopolists set prices above marginal cost, resulting in deadweight loss that affects both end-users and cumulative innovators.[2] This is a criticism of IP as an allocation mechanism, not a criticism of IP as an innovation incentive. We can imagine a scenario in which the government makes knowledge goods available to all on an open-access basis—and so avoids the deadweight loss problem—while purchasing patents from inventors for the expected net present value of the future patent profits. Such a system would be vulnerable to the "crowding out" objection, but not the allocative inefficiency objection.

Just as specific criticisms of IP tend to be directed at either the incentive element or the allocation element but not both, the virtues of IP tend to be particular to one element or the other. Consider the claim that IP is superior to government-set rewards such as prizes and grants because it leverages private information from market actors to establish payoffs.[3] This is a defense of IP as an innovation incentive, with only partial applicability to IP as an allocation mechanism. We can imagine a "patent buyout" scheme in which payoffs for innovators are set through an auction that leverages private information from market actors, while at the same time patented products are available to consumers on an open-access basis. The informational benefit of a market-set reward gives us a reason to adopt IP as an innovation incentive, but it does not necessarily weigh in favor of IP as an allocation mechanism. Alternatively, consider the claim that IP is superior to other innovation policies with respect to luxury goods because it embodies a normatively attractive user-pays principle.[4] This is a defense

1. *See* YOCHAI BENKLER, THE WEALTH OF NETWORKS: HOW SOCIAL PRODUCTION TRANSFORMS MARKETS AND FREEDOM 92-97 (2006) (discussing this "crowding out" effect).

2. *See, e.g.*, Amy Kapczynski, *The Cost of Price: Why and How to Get Beyond Intellectual Property Internalism*, 59 UCLA L. REV. 970, 982 (2012); Steven Shavell & Tanguy van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525, 529 (2001).

3. *See* Nancy Gallini & Suzanne Scotchmer, *Intellectual Property: When Is It the Best Incentive System?*, *in* 2 INNOVATION POLICY AND THE ECONOMY 51, 54-55 (Adam B. Jaffe et al. eds., 2002); Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 73 AM. ECON. REV. 691, 703 (1983).

4. *See* Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents-Prizes Debate*, 92 TEX. L. REV. 303, 349-51 (2013).

of IP as an allocation mechanism, but it tells us very little about how innovation incentives should be structured.

The incentive/allocation distinction not only clarifies current IP debates, but also opens up new possibilities for innovation policy. The recognition that we can use IP as an innovation incentive while allocating knowledge goods on an open-access basis prompts the question: where and why might we choose to do so? Further, once one realizes that IP innovation incentives can be combined productively with non-IP allocation mechanisms (and vice versa), it is a natural next step to consider whether and when we might choose to combine IP and non-IP mechanisms on the same side of the innovation/allocation divide. Here too, we can identify a wide range of circumstances in which IP/non-IP combinations can advance the goals of innovation law.

The combinatorial possibilities become even richer when we consider that domestic innovation policies exist in a globalized world, beneath a layer of international IP law. The international IP framework, we argue, functions as a mechanism for allocating the costs of innovation across countries, but it does not dictate the choice of innovation policies within countries. States can adopt their own non-IP innovation incentives and their own non-IP allocation mechanisms while remaining in compliance with their obligations under international IP treaties. And even if international law were to shift away from its current IP orientation, states might choose to use IP tools in order to incentivize innovation and allocate knowledge goods domestically. Domestic and international knowledge-good regimes are, we argue, largely separable both in theory and in practice.

While the examples above call on readers to engage in imaginative exercises, the claims of this Article are not exclusively theoretical. We argue that "pluralism"—as defined by the combination of IP and non-IP policies, or different types of non-IP policies—provides a more descriptively accurate account of the innovation policy landscape than those that dominate the existing literature. In other words, we can do more than imagine the possibility of combining IP and non-IP innovation incentives and allocation mechanisms in the ways described above. We can observe a wide range of real-world examples in which such combinations are already in use. But these real-world combinations appear to have arisen by happenstance rather than design, and proposals for further reform would benefit from more careful consideration of IP's distinct elements.

Our overarching objective is to set out a framework for the study of pluralistic innovation policy arrangements that can organize and motivate further research across subfields. In so doing, we introduce a new vocabulary for characterizing and comparing IP/non-IP combinations. First, as previewed above, we define and distinguish *innovation incentives*, which establish the payoff structure for producers of knowledge goods, and *allocation mechanisms*, which establish the conditions under which consumers can use knowledge goods. We then describe the three ways that IP and non-IP innovation incentives and allocation mechanisms can be combined. *Matching* involves the pairing of an IP innovation incentive with a non-IP allocation mechanism or vice versa, the pairing of a non-IP innovation incentive with IP as an allocation strategy. *Mixing* involves the combination of IP and non-IP innovation incentives, or IP and non-IP allocation mechanisms—that is, IP and non-IP tools are used on the same side of the incentive/allocation divide. Finally, *layering* refers to the use of different policies at different jurisdictional levels, such as using non-IP innovation incentives and allocation mechanisms at the domestic level within an international legal system oriented around IP. Theoretically, layering could work the other way, with IP at the domestic level and a non-IP mechanism for apportioning the costs of knowledge production across borders, though this latter alternative is rarely seen in practice.[5]

Part I provides an overview of the existing literature that compares IP with non-IP innovation policies such as prizes, grants, and tax preferences. With notable exceptions, that literature has focused on the choice *between* IP and non-IP alternatives rather than on how these policies might be fruitfully combined. Part II—the heart of the Article—explores the circumstances under which IP and non-IP innovation incentives and allocation mechanisms might be deployed together to advance innovation policy's broader goals. Part III moves from theory to practice and illustrates innovation policy pluralism in action, with particular attention to the pharmaceutical sector in the United States and abroad. This sector is generally treated as the strongest case for patents—even patent critic Richard Posner has called the pharmaceutical industry "the poster child for the patent system."[6] We show that, in practice, the policy mechanisms used for drug development and distribution involve substantial use of nonpatent innovation incentives and allocation mechanisms in conjunction with the patent system, all operating beneath a superstratum of international innovation law that looks quite

---

5. For an extended discussion of factors that may have led countries to converge around an international IP regime instead of coordinating on alternative knowledge-production mechanisms such as grants or prizes, see Daniel J. Hemel & Lisa Larrimore Ouellette, *Knowledge Goods and Nation-States*, 101 MINN. L. REV. 167, 226-34 (2016). Layering also refers to the use of different innovation policies at other jurisdictional levels, such as the layering of federal policy over state and local incentive and allocation choices. *See infra* note 146 and accompanying text.

6. Richard A. Posner, *Why There Are Too Many Patents in America*, ATLANTIC (July 12, 2012), https://www.theatlantic.com/business/archive/2012/07/why-there-are-too-many-patents-in-america/259725 [https://perma.cc/2C2R-KBMU]; *see also* MICHELE BOLDRIN & DAVID K. LEVINE, AGAINST INTELLECTUAL MONOPOLY 213 (2008) ("The pharmaceutical industry is the poster child of every intellectual monopoly supporter.").

different from its sublayers. Finally, Part IV illustrates the value of our mixing, matching, and layering framework outside the patent context, in other areas of intellectual property and across property law more generally.

I. INCENTIVIZING INNOVATION: PATENTS VS. PRIZES VS. GRANTS VS. TAX PREFERENCES

Although intellectual property law historically has been the principal field in which legal scholars have thought about innovation policy,[7] governments in fact encourage innovation and allocate access to knowledge goods through a wide variety of mechanisms in addition to IP.[8] In the United States, direct funding from the federal government through grants and national laboratories accounts for nearly one-quarter of the five hundred billion dollars spent on research and development (R&D) each year.[9] R&D tax incentives—specifically, the credit for increasing research activities under § 41 and the expensing of research and ex-

7. *See* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1576 (2003) ("Patent law is our primary policy tool to promote innovation."). By "intellectual property law," we mean all the legal frameworks through which knowledge-good producers can generate exclusivity, including patents, copyrights, trademarks, trade secrets, regulatory exclusivity, and state law IP protections. *See generally* 1 PETER S. MENELL ET AL., INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE: 2017, at 31-39 (2017) (providing a broad overview of various types of IP law).

8. By "knowledge good" we mean "anything that can be digitized," but our argument does not depend on the exact contours of this category. HAL VARIAN, MARKETS FOR INFORMATION GOODS 3 (1998). The important point is that many intangible goods will not be efficiently produced absent state intervention because they have characteristics of public goods: they benefit persons other than the producer (nonrivalry), and these persons are difficult to exclude from these benefits (nonexcludability).

9. *See* Nat'l Sci. Bd., *2018 Science & Engineering Indicators*, NAT'L SCI. FOUND. 4-20 tbl.4-3 (2018), https://www.nsf.gov/statistics/2018/nsb20181/assets/nsb20181.pdf [https://perma.cc/4ZM4-L45E] (reporting that the federal government funded $121 billion out of $495 billion total R&D expenditures in 2015).

perimental expenditures under § 174[10]—cost the federal government an additional twenty billion dollars.[11] When targeted R&D tax incentives such as those for orphan drugs are added to this tally, that number is even higher.[12] Government prizes are also a small but growing part of the U.S. policy toolkit for incentivizing innovation,[13] with the number of prize competitions conducted by federal agencies more than doubling between 2012 and 2016.[14]

In prior work, we developed a framework for comparing the advantages and disadvantages of these different tools, although we did not delve into whether or how different policies could be fruitfully combined. We also did not discuss—because we had not yet come to understand—the incentive/allocation distinction that is our focus in this Article. Our main argument was that every government transfer to spur investment in knowledge-good production embodies the answers to two distinct questions:

1. *Who decides* the size of the transfer?[15] In some cases, governments tailor rewards on a project-by-project basis, such as by setting a fixed prize for a particular technological improvement, awarding a grant to a researcher

---

10. I.R.C. §§ 41, 174 (2018). In its simplest form, § 41 provides a nonrefundable tax credit of twenty percent times qualified research expenses over a base amount, with the base amount calculated as a function of past spending. The details of the credit are extraordinarily complicated and lie beyond the scope of this Article. Section 174 allows firms to write off certain R&D costs immediately rather than amortizing them over several years. For an overview, see Hemel & Ouellette, *supra* note 4, at 322-26. Section 174 is now set to expire at the end of 2021, *see* Tax Cuts and Jobs Act, Pub. L. No. 115-97, § 13206 (to be codified at I.R.C. § 174(e)), but informed observers expect a concerted lobbying effort to extend that provision beyond the current sunset date, *see How Tax Reform Affects Companies Conducting R&D*, MOSSADAMS (Jan. 2018), https://www.mossadams.com/articles/2018/january/tax-reform-affects-rd-credits [https://perma.cc/FP7D-R3ZS].

11. *See* Office of Tax Analysis, *Tax Expenditures*, U.S. DEP'T TREASURY 21 tbl.1 (Oct. 16, 2017), https://www.treasury.gov/resource-center/tax-policy/Documents/Tax-Expenditures-FY2019.pdf [https://perma.cc/Y8U8-6XFF] (reporting the cost of these incentives as $19.8 billion in 2017).

12. *See id.* at 24 tbl.1. The federal tax law passed in December 2017 cuts the value of the orphan drug credit in half. *See* Tax Cuts and Jobs Act, Pub. L. No. 115-97, § 13401(a) (to be codified at I.R.C. § 45C(a)).

13. *See Newest Challenges*, CHALLENGE.GOV, https://www.challenge.gov [https://perma.cc/VML9-UFJV] (listing open prize competitions); *see also* Hemel & Ouellette, *supra* note 4, at 317-19 (discussing the recent growth in government prizes).

14. *See* Office of Sci. & Tech. Policy, *Implementation of Federal Prize Authority: Fiscal Year 2016 Progress Report*, EXECUTIVE OFF. PRESIDENT U.S. 13 tbl.3 (July 7, 2017), https://www.challenge.gov/toolkit/files/2017/07/FY2016-Implementation-Federal-Prize-Authority-Report-and-Appendices.pdf [https://perma.cc/RUL8-TPWG].

15. *See* Hemel & Ouellette, *supra* note 4, at 327-33.

for a particular project, or budgeting a certain amount for specified research at government labs. In contrast, for patents and general R&D tax preferences, the government sets relatively technology-neutral ground rules, and the reward size is largely determined by market forces.[16] To be sure, "market-set" rewards such as patents and general R&D tax preferences still involve some degree of state involvement, but government officials do less to pick winners (or potential winners) in those cases than in the context of prizes, grants, and research at government labs.

2. *When* is the reward transferred?[17] Some mechanisms, such as grants, research at national labs, and tax credits, are provided ex ante for all projects, before the results are known. Others, such as prizes and patents, are awarded ex post for only those projects that turn out to be successful.[18]

These two dimensions are illustrated below in Figure 1.[19]

---

16. To be clear, there are many government decisions embedded in "market-set" transfers; for example, they may vary in size, such as based on the size of the tax credit or the length and scope of the patent rights. Moreover, tax credits are currently based on the input of R&D costs rather than the output of excludable social value, and it is not obvious which would be most closely aligned with optimal transfer size. *See id.* at 329-32. But the specific details of either class of incentives might be adjusted. *See, e.g.*, Lisa Larrimore Ouellette, *Adjusting Patent Damages for Nonpatent Incentives*, 26 TEX. INTELL. PROP. L.J. 187, 187-88 (2018) (noting that patent damages could be calculated based on risk-adjusted R&D costs, accounting for costs of nonpatent incentives). For our purposes, the important point is that for any of these innovation policy mechanisms, the government is not making technology-specific judgments about which projects should be pursued.

17. *See* Hemel & Ouellette, *supra* note 4, at 333-45.

18. For the purposes of this framework, we treat patents as akin to other mechanisms for providing exclusivity, including other forms of IP (such as trade secrets and trademarks) and FDA-administered regulatory exclusivity. The differences among these exclusivity mechanisms, while important, are not our focus here. *See infra* notes 161-163 and accompanying text.

19. *See* Hemel & Ouellette, *supra* note 4, at 333 fig.1. We also noted a third dimension, which foreshadowed our incentive/allocation distinction here: *who pays* for the knowledge production—all taxpayers, or only users of the resulting products and services? *See id.* at 345-52. To allocate access to knowledge goods, the patent system relies on proprietary pricing, with users paying a price for the good set by a patent holder who exerts market power. Many knowledge goods in the United States, however, are distributed or subsidized by the government. Prominent examples include the Medicare Part D program and Medicaid, through which patented drugs are distributed to patients at deep discounts. *See infra* notes 165-171, 182-186 and accompanying text.

FIGURE 1.
INNOVATION INCENTIVES: WHO DECIDES AND WHEN?

		Reward Setting	
		Government-set (government selects projects and reward sizes)	**Market-set** (government creates technology-neutral rules)
Reward Timing	**Ex ante** (reward before results)	Direct spending (grants, procurement contracts, national labs)	R&D tax preferences
	Ex post (only reward success)	Fixed prizes	IP and other exclusivity; market-based prizes; patent boxes

Although we have drawn discrete boxes for simplicity, each dimension is a continuous spectrum rather than a binary choice.[20] Imagine, for example, that policy makers want to encourage development of a Zika virus vaccine, and assume for now that the reward will be paid ex post. If policy makers favor a government-set reward, they could offer a fixed one-billion-dollar prize for the first innovator to develop an effective vaccine; if they favor a market-set reward, they could offer monopoly rights for the first vaccine producer (resulting in a reward entirely based on consumers' willingness to pay). Yet there are also a number of intermediate solutions. For example, the government might offer a prize of fifty dollars per person inoculated, which would reflect a government assessment of inoculation's social value as well as information based on consumer choices regarding the new vaccine's appeal.[21] Similarly, we can imagine an array of intermediate solutions on the vertical reward-timing axis because transfers can be

20. While the who-decides and reward-timing questions are critical dimensions in the design of innovation incentives, they are not—of course—the only choices that matter. For a thorough discussion of policy choices within the "grants" box, see W. Nicholson Price II, *Grants*, 34 BERKELEY TECH. L.J. (forthcoming 2019), https://ssrn.com/abstract=3174769.

21. A similar market-based prize, with a subsidy per dose sold, is being used to incentivize global distribution of pneumococcal vaccines. *See How the Pneumococcal AMC Works*, GAVI: THE VACCINE ALLIANCE, https://www.gavi.org/funding/pneumococcal-amc/how-the-pneumococcal-amc-works [https://perma.cc/TK8E-JBDA]. The proposed Health Impact Fund would similarly entail a more comprehensive market-based medical-prize scheme. *See* AIDAN HOLLIS &

scheduled at any time during the R&D process, based on varying demonstrations of success.

The existence of intermediate solutions does not, in our view, detract from the usefulness of the government-set/market-set and ex ante/ex post distinctions. Some of the most oft-used dichotomies in legal analysis, such as rules versus standards[22] and property rules versus liability rules,[23] also admit of intermediate cases and blurred lines.[24] Framing a problem in polar terms allows us to focus on the reasons why policy makers might prefer to tilt more in one direction than the other—i.e., why policy makers might prefer more or less government involvement in setting reward size, and why policy makers might prefer earlier or later delivery of those rewards. That approach can, we submit, serve to clarify consequential policy choices even when (and indeed *because*) it simplifies complex phenomena.

The chief arguments relevant to the horizontal axis (government-set vs. market-set) will be familiar to many readers. Government-set rewards entail an informational burden that bureaucrats may be ill equipped to handle, even with mechanisms like peer review and expert panels for consolidating information. Markets, by contrast, aggregate widely dispersed information regarding consumers' willingness to pay for new knowledge goods. Weighing in favor of government-set rewards, however, is the argument that willingness to pay may be an imperfect proxy for social value. Market institutions may assign a reward that is too low (relative to social value) for knowledge goods that generate positive externalities when consumed, such as low-emission vehicles or smoking-cessa-

---

THOMAS POGGE, THE HEALTH IMPACT FUND: MAKING NEW MEDICINES ACCESSIBLE FOR ALL 13-26 (2008). As we discuss later, even though such schemes involve more market information than a fixed prize, they provide less information about how much consumers value a new innovation over substitutes than above-marginal-cost pricing. *See infra* note 138 and accompanying text.

22. *See* Louis Kaplow, *Rules Versus Standards: An Economic Analysis*, 42 DUKE L.J. 557, 577-78 n.47 (1992) (noting importance of "intermediate cases"); Pierre Schlag, *Rules and Standards*, 33 UCLA L. REV. 379, 383 n.19, 391 n.27, 394-97, 403-04, 406-08, 423 & n.94, 427-28 (1985) (characterizing different legal directives as more or less "rule-like" or "standard-like").

23. *See* Saul Levmore, *Unifying Remedies: Property Rules, Liability Rules, and Startling Rules*, 106 YALE L.J. 2149, 2153-57 (1997) (noting intermediate and more extreme positions on the property-liability spectrum).

24. For example, the rule "no vehicles in the park" defers to later decision makers what constitutes a "vehicle," and that latter inquiry may be more standard-like than rule-like. Similarly, a no-trespass rule enforced exclusively through the payment of fines seems to straddle the property rule/liability rule divide.

tion technologies. Conversely, market institutions may prove superior to government-set rewards when political pathologies skew policy outcomes toward the interests of the powerful few.[25]

With respect to the vertical axis, ex ante rewards carry three significant advantages over ex post rewards. First, ex ante payouts minimize the need for potential innovators to raise capital from private investors. When rewards are paid out ex post, potential innovators (or, at least, those without large cash reserves) must raise capital to cover costs during the interim period between when a project is undertaken and when its result becomes known. This bridge financing entails significant transaction costs even in relatively well-functioning capital markets, as in the market for venture-capital investment in Silicon Valley.[26] Second, ex ante payouts reduce the risk borne by potential innovators who pursue uncertain projects: the ex ante payment covers at least a portion of the innovator's costs and thus leaves the innovator with less to lose in the event that the project fails. This risk-reduction aspect is particularly advantageous if potential innovators tend to be risk-averse.[27] Third, ex ante rewards confer more "bang" for the government's innovation-incentivizing "buck" when potential innovators are particularly present-minded (or, more specifically, when potential innovators have higher discount rates than society at large).[28] Under those circumstances, the benefit to potential innovators of accelerating payment exceeds the cost to the government of money's time value.

The case for ex ante rewards, however, is not airtight. For one thing, ex ante rewards arguably entail greater informational burdens than ex post rewards, at least on the government-set side of the divide. That is, it may be easier for the government to set a goal and a reward size (e.g., *X* dollars for the first team to develop a Zika virus vaccine) than for the government to pick the projects most

25. To be sure, markets can and often do disfavor the less powerful when the value of a good to an individual user exceeds his or her ability to pay. *See infra* note 95 and accompanying text.

26. *See* Hemel & Ouellette, *supra* note 4, at 334-39.

27. *See id.* at 340-42. Andres Sawicki has questioned this assumption. *See* Andres Sawicki, *Risky IP*, 48 LOY. U. CHI. L.J. 81 (2016). But his observations of creators who succeeded despite enormous risk do not indicate that these creators would not have preferred less risk. *See id.* at 116-17. And even if some creators are risk-seeking, much investment in knowledge production comes from firms that show behavior consistent with risk aversion. *See* Daniel A. Rogers, *Does Executive Portfolio Structure Affect Risk Management? CEO Risk-Taking Incentives and Corporate Derivatives Usage*, 26 J. BANKING & FIN. 271 (2002). Note, however, that a firm's risk profile is likely to be affected by its executive compensation contracts, and that any general statement about firm risk attitudes is unlikely to hold in all circumstances. *See id.* at 274 ("Depending on the extent of convexity in the contract, the manager could be induced into less risk averse, risk-neutral, or even risk-seeking behavior.").

28. *See* Hemel & Ouellette, *supra* note 4, at 342-44.

likely to reach that goal and the appropriate grants for each such project (e.g., *Y* dollars for the Zika virus vaccine project at the Centers for Disease Control, *Z* dollars for the Zika project at the National Institutes of Health (NIH), *Q* dollars for the Zika project at Harvard Medical School, and so on). Furthermore, ex post rewards may better incentivize potential innovators to pursue projects with gusto (e.g., a researcher may be less likely to slack off if she is competing with other researchers for a future prize than if she already has a government grant that covers her costs).

In sum, no single innovation-incentive mechanism is uniformly superior in all circumstances. Direct spending through grants, procurement contracts, and in-house research at federal agencies will be most effective where market signals are poor proxies for social benefits, capital constraints are significant, and the government has a comparative advantage in assessing the costs and benefits of potential projects. (Space exploration arguably satisfies all of these criteria.[29]) Fixed prizes are most effective for projects such as algorithmic challenges, for which the government can set a clear goal but is at a disadvantage for identifying the most promising projects, and where capital constraints are less significant. Patents, like prizes, are most effective when innovators have ready access to the necessary financial capital and when the negative effects of risk aversion are limited. Patents are preferable to prizes when market signals provide superior information about social benefits than the government can easily acquire (such as for pharmaceuticals affecting wealthy populations), and prizes are preferable to patents when willingness to pay is a poor proxy for social value (such as for vaccines aimed at contagious diseases primarily afflicting the very poor). Finally, refundable tax credits, like patents, are most effective when the government is at a disadvantage evaluating projects, but they may be more effective than patents when researchers face a high risk of failure and run up against binding capital constraints. A transformative leap in battery technology might be one such example. Of course, all of these conclusions are contingent on the specific implementation of the incentive policies as well as on factual details about the technical field. The goal of our prior work was to illuminate the key differences between these innovation policy tools and to highlight the most important factors that might lead policy makers to choose one over the others.

29. The rise of SpaceX, entrepreneur Elon Musk's space technology venture, is not necessarily a counterexample. SpaceX relies heavily on contracts with NASA, which "has long been SpaceX's most important customer" and will provide most of the funding for the Dragon 2 craft that will make SpaceX's much-anticipated moon trip. *See* Samantha Masunaga, *Don't Expect a Space Race Between SpaceX and NASA. They Need Each Other*, L.A. TIMES (Mar. 5, 2017, 7:00 AM), https://www.latimes.com/business/la-fi-spacex-nasa-20170301-story.html [https://perma.cc/MFU6-Q3D9].

So far, we have focused on when different incentives might individually be most effective. The rich theoretical literature on IP versus non-IP alternatives has relatively little to say about when these different innovation policies might operate effectively in combination. As we discuss in Part III, innovation policy pluralism is not merely theoretical—the real world involves significant mixing and matching of different policy tools. In the United States, recipients of federal grants, prizes, and R&D tax credits need not relinquish their patent rights,[30] and there are a number of specific policies such as the Orphan Drug Act that offer an array of incentives for a targeted goal.[31] But while some empirical and descriptive studies of innovation systems in practice have necessarily discussed complementary policies,[32] and some contributions to the extensive patents-versus-prizes literature have concluded that the optimal solution involves both,[33] scholars of innovation law and policy lack a general framework for characterizing and comparing IP/non-IP combinations. Part II of this Article seeks to fill that gap.

II. OPTIMIZING OUTCOMES: MATCHING, MIXING, AND LAYERING INNOVATION POLICIES

In this Part, we present an original taxonomy designed to categorize the various ways that governments can combine innovation policies rather than rely on a "pure IP" or "pure non-IP" approach. We focus on IP versus non-IP because of IP's dominance in the legal literature on innovation, but this taxonomy also

---

30. *See* 15 U.S.C. § 3719(j)(1) (2018); 35 U.S.C. §§ 200-212 (2018).

31. Pub. L. No. 97-414, 96 Stat. 2049 (1983) (codified as amended in scattered sections of 15, 21, 42 & 46 U.S.C.). The Act provides (1) increased grants for orphan drug development, 21 U.S.C. § 360ee (2018); (2) seven years of patent-like market exclusivity, *id.* § 360cc; and (3) a tax credit for fifty percent of a pharmaceutical firm's clinical testing expenses for orphan drugs, I.R.C. §§ 45C, 280C, 6096 (2018).

32. *See, e.g.*, Pierre Azoulay et al., *Public R&D Investments and Private-Sector Patenting: Evidence from NIH Funding Rules*, REV. ECON. STUD. (forthcoming) (manuscript at 1), https://doi.org/10.1093/restud/rdy034 [https://perma.cc/JZ62-7ECX] (finding that "a $10 million boost in NIH funding leads to a net increase of 2.3 patents"); Liam Brunt et al., *Inducement Prizes and Innovation*, 60 J. INDUS. ECON. 657 (2012) (finding that patents and complementary U.K. prizes offered between 1839 and 1939 both boosted innovation); Henry G. Grabowski et al., *The Roles of Patents and Research and Development Incentives in Biopharmaceutical Innovation*, 34 HEALTH AFF. 302 (2015) (summarizing the array of incentives available for pharmaceuticals); Yuri Simachev et al., *Public Support for Innovation in Russian Firms: Looking for Improvements in Corporate Performance Quality*, 21 INT'L ADVANCES ECON. RES. 13 (2015) (comparing tax incentives and public subsidies for Russian firms).

33. *See, e.g.*, V.V. Chari et al., *Patents and Prizes: Using Market Signals to Provide Incentives for Innovations*, 147 J. ECON. THEORY 781 (2012).

applies to combinations of different non-IP policies. We first distinguish between *innovation incentives* and *allocation mechanisms*. The IP system, for example, consists of an ex post, market-based innovation incentive combined with an allocation mechanism relying on proprietary pricing. We then consider innovation policy matches and mixes. By *matching*, we mean the use of IP law on one side of the incentive/allocation divide and a non-IP policy on the other side.[34] By *mixing*, we mean the combination of IP and non-IP policies on the same side of the incentive/allocation divide. Finally, we discuss the possibility of using different innovation policies at different jurisdictional levels, such as using non-IP incentives and allocation mechanisms at the domestic level while using the international IP regime as a framework for global cost-sharing—a strategy we refer to as *layering*. We also seek to show how our typology of matching, mixing, and layering has the potential to organize and motivate further research on pluralistic innovation policy arrangements.

A. *Incentivizing Innovation vs. Allocating Access*

The starting point for our analysis is the distinction between innovation incentives and allocation mechanisms. By *innovation incentive*, we mean the payoff structure for developing a new knowledge good. By *allocation mechanism*, we refer to the conditions under which consumers and firms can gain access to knowledge goods themselves. Both aspects of IP have been recognized by prior scholars,[35] but we think that disentangling innovation incentives from allocation mechanisms clarifies the terms of current debates and opens up new possibilities for policy experimentation.

34. Some readers may object that "matching" is used in common parlance to refer to the pairing of two of the same (e.g., matching one checkered glove with another). Even in that context, though, "matching" implies complementarity rather than identity (i.e., matching the left checkered glove with the right). *See* Ruth La Ferla, *'Nothing Says Chic Like Matching Your Drink to Your Dress*,*'* N.Y. TIMES (Feb. 7, 2018), https://www.nytimes.com/2018/02/07/fashion/lela-rose-trunk-show-new-york-fashion-week.html [https://perma.cc/FZQ4-HK5Z] ("'I thought of matching the canapés to the drinks,' [fashion designer Lela Rose] said, rolling her eyes, but not really abashed."). We use the term "matching" to refer to complementary combinations of elements that cross the innovation-incentive/allocation-mechanism divide, though we acknowledge that other authors might have chosen different terminology.

35. For a few examples of articles describing IP's allocative function, see Chari et al., *supra* note 33; Harold Demsetz, *Information and Efficiency: Another Viewpoint*, 12 J.L. & ECON. 1, 19-20 (1969); Kapczynski, *supra* note 2; and Peter Lee, *Toward a Distributive Agenda for U.S. Patent Law*, 55 HOUS. L. REV. 321, 340 (2017).

In a pure IP system, the innovation incentive—the payoff structure for developing a new knowledge good—is relatively straightforward. The potential innovator—an individual, firm, or joint venture—bears the cost of research and development, and if the R&D effort fails, the innovator receives no reward. If the effort succeeds in yielding a new knowledge good that meets the criteria for patentability, the innovator obtains a time-limited exclusive right over the use of the knowledge good. The payoff to the innovator in the event of success is equal to the value of supracompetitive rents she can earn during the patent's life. For simplicity, we will refer to these as monopoly rents, although in practice many patents and other forms of IP do not offer monopoly power.[36]

In a pure prize system, the potential innovator bears the cost of R&D, and receives no reward in the event of failure.[37] If the effort succeeds in yielding a new knowledge good that meets the criteria set by the prize-awarding entity, the innovator receives a set payment.[38] The key distinction between patents and fixed prizes on the innovation-incentive side is that market forces determine the size of the patent reward, whereas a nonmarket institution determines the size of the prize. To be sure, patent rents are typically earned over the course of a twenty-year patent life while prizes are typically paid as lump sums, but these are not inherent characteristics of patents or prizes. Patentees can choose to sell their monopoly rights for a lump sum at any point (including to government purchasers),[39] and prizes can be paid out incrementally over time.[40]

---

36. Models often treat patents as granting monopolies over particular markets, but the link between patents and markets is more attenuated. *See* Robert P. Merges & Michael Mattioli, *Measuring the Costs and Benefits of Patent Pools*, 78 OHIO ST. L.J. 281, 325-27 (2017); Stephen Yelderman, *Do Patent Challenges Increase Competition?*, 83 U. CHI. L. REV. 1943, 1960-72 (2016). Of course, patents are effective at facilitating transfers from consumers to producers only to the extent that they offer some form of market power.

37. In practice, innovation inducement prizes often mix features of what we refer to as a "pure prize system" with other policy tools. *See, e.g.*, Michael J. Burstein & Fiona E. Murray, *Innovation Prizes in Practice and Theory*, 29 HARV. J.L. & TECH. 401 (2016); Benjamin N. Roin, *Intellectual Property Versus Prizes: Reframing the Debate*, 81 U. CHI. L. REV. 999 (2014).

38. A 1999 National Academy of Engineering report urged the federal government to make greater use of technology inducement prizes, *see* NAT'L ACAD. OF ENG'G, CONCERNING FEDERALLY SPONSORED INDUCEMENT PRIZES IN ENGINEERING AND SCIENCE app. A at A-1 (1999), and the government has done so on a limited scale, *see About*, CHALLENGE.GOV, https://challenge.gov/a/buzz/pages/about-us [https://perma.cc/27E5-EBPV].

39. Indeed, many patentees do sell to various patent-aggregating intermediaries. *See* Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 COLUM. L. REV. 2117, 2126-29 (2013) (describing these business models).

40. As noted above, governments can also blend features of patents and prizes in a single policy tool, such as prize systems in which the reward is tied to a market signal such as sales volume.

Pure grant systems (including research at government labs) and pure R&D tax credits differ from patent and prize systems on the incentive side in that potential innovators do not bear the full cost of R&D activities and their payoffs do not depend on the results of a particular project.[41] This is not to say that potential innovators have no incentive to succeed under these ex ante systems. An innovator's past performance, for example, may affect future grants.[42] Likewise, an innovator's ability to offset tax liabilities using the federal tax credit may depend on overall profitability (and thus, the overall success of the innovator's various projects). Moreover, these ex ante mechanisms vary in the degree to which the government determines the share of R&D costs offset. Grant systems and government research require much more picking and choosing of projects by government officials (aided by government-designed peer-review mechanisms), while government assessments of the social value of a particular project do not determine the size of the federal tax credit. Our goal here is not to delve into the details of these mechanisms but to emphasize that each entails a tunable innovation-incentive component. That is, each offers potential innovators a payoff structure that determines the extent to which she will bear R&D costs and the rewards she will receive contingent upon different project outcomes.

Importantly, the innovation-incentive component is not the only relevant feature of an innovation policy. We use the term "allocation mechanism" to refer to the terms under which consumers and firms can gain access to knowledge goods. A pure patent system relies on temporary monopoly pricing for access allocation.[43] During the life of the patent, the patent holder sets the price that consumers and firms must pay to use the knowledge good, and those who use the knowledge good without paying that price are liable for infringement. Variations on the theme are possible to imagine. Ian Ayres and Paul Klemperer, for example, have proposed a modified patent regime that would confer exclusive

See Roin, *supra* note 37, at 1058 (noting that "[m]ost proposals for prize systems rely on observing sales volume to calculate prizes").

41. *See* Hemel & Ouellette, *supra* note 4, at 320-26 (discussing the use of direct spending on grants and government labs and the use of R&D tax incentives in the United States); *see also supra* note 10 (discussing I.R.C. § 41). Whether potential innovators "bear the full cost of R&D activities" when they expense research costs under § 174 is a more complicated question. The answer depends on whether the relevant tax system is income-based or consumption-based. In an income-based system, expensing R&D costs is economically equivalent to amortizing R&D costs along with the government paying a portion of the firm's R&D budget. In a consumption-based system, expensing is the norm (for R&D and non-R&D costs alike).

42. *See* Price, *supra* note 20, at 35-38.

43. Again, we refer to "monopoly pricing" for simplicity, even though patents often confer a more limited ability to set supracompetitive prices. *See supra* note 36 and accompanying text.

rights for each invention upon two sellers rather one.[44] The Ayres-Klemperer proposal would replace the standard allocation mechanism of monopoly pricing with an alternative of duopoly pricing.[45] At the other end of the spectrum is open access: a knowledge good could be placed into the public domain immediately, so that all consumers and firms could use it for free. And any of these regimes could be combined with a system of subsidies—for example, monopoly pricing with a subsidy for purchase. U.S. taxpayers can claim a federal tax credit for thirty percent of the expenses of a solar array,[46] but solar-cell patentees can still charge supracompetitive prices to the full extent their market power allows.

This menu of allocation options is far from exhaustive. For present purposes, we stress that the choices of innovation incentive and allocation mechanism are distinct. We can imagine a regime in which the government offers to buy patent rights from successful innovators at a price equal to the net present value of future monopoly rents and then places the patented inventions in the public domain. If the assessment of future rents is accurate, then the payoff structure looks identical to a patent system from the innovator's perspective, but the allocation mechanism is one of open access rather than monopoly pricing. Or we can imagine a regime in which innovation occurs inside government agencies, but the government then auctions off monopoly rights with respect to the resulting knowledge goods. From the perspective of the researchers working on the R&D project, the incentive structure looks identical to research within government labs, but the allocation mechanism is one of monopoly pricing. We discuss additional possible matches of innovation incentives and allocation mechanisms at greater length below.

---

44. Ian Ayres & Paul Klemperer, *Limiting Patentees' Market Power Without Reducing Innovation Incentives: The Perverse Benefits of Uncertainty and Non-Injunctive Remedies*, 97 MICH. L. REV. 985, 1031 (1999). As the authors explain, a patent could "give the holder two entitlements: the right to be one of only two producers of the product, and the right to receive the proceeds from the auction selecting the second producer of the product." *Id.* (footnote omitted). Assuming that collusion between the patentee and the auction winner could be policed effectively, the result is that the patentee would become one of two duopolists in the product market, commanding a price above the perfectly competitive price but below the monopoly price. *Id.* at 1032.

45. *Id.* The proposal could be modified to provide for triopoly pricing, quadropoly pricing, and so on. A cruder version of this proposal would involve capping the price someplace above marginal cost, which could be done in exchange for some government buyout, although the upper bounds of prices would then no longer be set by the market.

46. I.R.C. § 25D(a)(1) (2018). The thirty-percent rate is applicable to "qualified solar electric property expenditures" placed in service after December 31, 2016, and before January 1, 2020. *Id.* § 25D(g)(1).

B. *Matching Incentives with Allocation Mechanisms*

As emphasized above, the term "intellectual property" denotes a specific match between an innovation incentive (an ex post reward based on a market-generated estimate of social value) and an allocation mechanism (monopoly pricing). Importantly, policy makers can and sometimes do partially decouple these elements from one another. They can match an innovation incentive that relies on an ex post, market-generated estimate of social value with an allocation mechanism of open access. Alternatively, policy makers can match a non-IP innovation incentive with an allocation mechanism of monopoly pricing. This Section explores both possibilities and explains why matching strategies might be desirable under certain circumstances. As we explain, the decoupling is only partial—IP incentives require *some* probability of IP allocation to generate a market estimate of value,[47] and the choice of allocation mechanism may feed back into the innovation incentive to the extent that innovators care about how their knowledge goods are allocated.[48] The important point is that incentives and allocation are far more separable than generally realized.

1. *Matching IP Innovation Incentives with Non-IP Allocation Mechanisms*

We start with the possibility of matching an IP-like innovation incentive with a non-IP allocation mechanism. Matching of this sort might be optimal when policy makers want to encourage innovation with an ex post, market-set reward, but without the allocative inefficiency and cost to cumulative innovation that comes with monopoly pricing. In the terms of Figure 1, the idea is to create an innovation incentive in the lower right-hand box, but without the deadweight loss of IP monopoly pricing.

One way to achieve this goal is for the government to purchase patent rights from a patent holder and then to place the patent in the public domain. A rational, self-interested patent holder will sell rights to the government only if offered a price that equals or exceeds the net present value of future patent rents. The market (or, more accurately, the patent holder's expectation of her own market reward) thus sets the lower bound on the payoff to the innovator. Once the

---

47. *See infra* note 64 and accompanying text.

48. For example, even in a system of purely non-IP innovation incentives, IP allocation mechanisms might decrease incentives for researchers who are opposed to anyone propertizing and profiting from their inventions, or they might increase incentives for researchers who think that IP-based allocation will promote commercialization and widespread adoption of their ideas. *See infra* notes 221-223 and accompanying text.

patent is in the public domain, access is free, and so the deadweight loss of monopoly pricing is eliminated. Of course, the government must raise the additional tax revenues to purchase the patent, but revenue raising through broad-based taxation will generally be more efficient than taxing a single market through monopoly pricing.[49] Indeed, Steven Shavell and Tanguy van Ypersele argue that such a system of optional government patent buyouts is always more efficient than a pure patent system.[50]

On various occasions, governments have purchased patent rights from innovators and then placed those knowledge goods in the public domain. South Carolina purchased the in-state rights to the cotton gin from inventor Eli Whitney in 1802.[51] Thirty-seven years later, the French government bought the patent for the Daguerreotype photographic process from the inventor, Louis Jacques Mande Daguerre, and then allowed free use of the Daguerreotype process everywhere except England.[52] The Daguerreotype example incorporates both matching and layering, combining an IP innovation incentive and a non-IP allocation mechanism at the domestic level with the use of international IP law to collect patent rents from foreign consumers.

More recently, the United Kingdom implemented a system known as the Pharmaceutical Price Regulation Scheme (PPRS). The taxpayer-funded National Health Service purchases medicines from patent holders and then distributes drugs domestically at zero cost or a discounted price.[53] PPRS links rewards to market prices in two ways. First, the prices offered to pharmaceutical firms under PPRS are intended to be "value-based."[54] Second, and perhaps more important, a pharmaceutical firm unsatisfied with the PPRS price can choose to sell its products on the unsubsidized market to patients willing to pay out of pocket or with private insurance.[55] The firm's estimate of the total market value of its

---

49. *See* Gallini & Scotchmer, *supra* note 3, at 54.

50. Shavell & van Ypersele, *supra* note 2, at 539.

51. *See* Michael Kremer, *Patent Buyouts: A Mechanism for Encouraging Innovation*, 113 Q.J. ECON. 1137, 1145 (1998).

52. *See id.* at 1144.

53. *See* Fin. & NHS/Meds., Pharmacy & Indus. Grp./17080, *The Pharmaceutical Price Regulation Scheme 2014*, DEP'T HEALTH & ABPI (Dec. 2013), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/675465/The_pharmaceutical_price_regulation_scheme_2014.pdf [https://perma.cc/T49M-G3LS].

54. *Id.* at 23.

55. *Id.* at 9 (describing the PPRS as a "non-contractual voluntary scheme"); *see also* Sarah Boseley, *UK NHS Cancer Patients Denied Drugs Due to Inflated Prices—Experts*, GUARDIAN (Sept. 23, 2015, 10:47 AM EDT), https://www.theguardian.com/business/2015/sep/23/uk-cancer-patients-being-denied-drugs-due-to-inflated-prices-say-experts [https://perma.cc/92LE patent in the absence of government subsidies thus sets a lower bound on the price that it will accept. If the government's offer is below the patent holder's estimate of the market value, the patent holder will go to market rather than transacting with the government. Conversely, if the patent holder does transact with the government, then the relevant knowledge good is distributed to patients at marginal cost.[56]

A more intricate strategy for matching an IP-based innovation incentive with an open-access allocation mechanism involves an auction scheme like that proposed by economist Michael Kremer. Under Kremer's proposal, patent holders could trigger a sealed-bid second-price auction in which investors would bid for patent rights.[57] With some probability p (based on randomized selection), the auction winner would purchase the patent from the holder at the second price. The auction winner would then hold the patent and be able to earn monopoly profits from sales of the relevant good.[58] With probability $1 - p$, the patent rights would not go to the auction winner, and instead the government would buy the rights from the patent holder at the auction-determined second price and then place the patent in the public domain for all to use.[59] In all cases, the inventor's reward would be set by the expected market returns. Only in portion p of cases, though, would access to the knowledge good be allocated to consumers based on monopoly pricing. In all other cases, access would be free.

The ingenuity of the patent buyout proposal is that if p is sufficiently greater than zero, profit-motivated private parties will have an incentive to participate in the auction and reveal their true valuations of the patent.[60] At the same time, p can be significantly less than 1, such that in many cases (and maybe even a majority of cases), the relevant knowledge good will be placed in the public domain.[61] A patent buyout scheme, if successful, thus combines some of the most attractive elements of IP as an innovation incentive and open access as an allocation mechanism. Like an IP-based system, a patent buyout scheme relies on market actors rather than government officials to estimate the value of a new knowledge good, and it harnesses the motivational power of an ex post reward.

-TBE2] (describing bargaining breakdowns when pharmaceutical companies would not lower prices to the point that the National Health Service deemed cost-effective).

56. *See* Hemel & Ouellette, *supra* note 5, at 221-22 (analyzing this scheme).

57. *See* Kremer, *supra* note 51, at 1146.

58. *Id.* at 1146-47 & fig.I.

59. *Id.* at 1147 fig.I.

60. This mechanism is vulnerable to collusion, although Kremer discusses a number of mechanisms to minimize this risk. *Id.* at 1157-62.

61. *Id.* at 1146-52.

Like a non-IP mechanism, patent buyouts lead to free access in most cases and thus avoid the added deadweight loss of proprietary pricing.[62]

There are many possible variations on the patent buyout idea. Kremer proposes a voluntary system in which patent holders first would decide whether to trigger an auction at all, and then would decide whether or not to sell the patent at the auction-determined price.[63] By contrast, one can imagine a mandatory system in which all patents are put up for auction once they are granted or some number of months or years thereafter, or a system in which patent holders who trigger the auction are bound to sell at the end of the process. For present purposes, the details of the patent buyout scheme matter less than the conceptual point that the proposal illustrates: IP-like innovation incentives that provide innovators with an ex post, market-determined reward (similar to the incentives currently provided by patents) can be coupled with allocation mechanisms that generally allow for open access to knowledge goods.[64]

2. *Matching Non-IP Innovation Incentives with IP-Based Allocation Mechanisms*

We have considered matches between IP-like innovation incentives and non-IP access allocation mechanisms—matches designed to leverage the informational value of monopoly power while achieving the allocative efficiency of open access. One can also imagine matches in the opposite direction: arrangements that rely on monopoly power to allocate access to knowledge goods even while non-IP tools are used to incentivize innovation. We have already discussed why

62. If the government finances patent buyouts with revenue from a broad-based tax, there will still be administrative and compliance costs associated with revenue-raising (though not necessarily any labor market distortion). *See* Louis Kaplow, *On the (Ir)Relevance of Distribution and Labor Supply Distortion to Government Policy*, J. ECON. PERSP., Fall 2004, at 159, 164-68.

63. *See* Kremer, *supra* note 51, at 1147 fig.I.

64. We underscore the adverb "generally." The matching of IP-like innovation incentives with pure open-access allocation mechanisms still requires *some* IP on the allocation side in order to generate a market estimate of value (as in the p cases in Kremer's patent auction in which the patent is sold on the private market). The key point is that an open-access allocation is possible for at least some IP-incentivized knowledge goods (in Kremer's proposal, the $1 - p$ cases where the government purchases the patents at the auction-determined price). This conclusion contrasts with the discussion that follows regarding the matching of non-IP innovation incentives with IP allocation mechanisms, where a one-to-one match is possible. That is, a state could rely entirely on a non-IP innovation incentive (e.g., the production of knowledge goods in a government-run lab) and then allocate access entirely through monopoly pricing. But even there, the access allocation mechanism might create feedback effects on the innovation incentive. *See infra* notes 221-223 and accompanying text.

non-IP innovation incentives might be superior in some cases,[65] but why might a policy maker choose an IP-based access allocation mechanism despite its greater allocative inefficiency? One reason, as noted above, is that monopoly pricing embodies a user-pays principle that might be *distributively* preferable for some knowledge goods, such as lifestyle drugs or luxury products.[66] But this sort of matching can also promote *efficiency* in at least two circumstances: first, when monopoly power mitigates collective action problems with respect to commercialization; and second, when consumption of the relevant knowledge good generates negative externalities that make open access undesirable.

We start with the commercialization concern. Imagine that an innovator applies for and obtains a patent covering a promising new pharmaceutical compound that treats cancer in mice. The government then buys the patent—either in a bilaterally negotiated exchange or through an auction process along the lines of the Kremer proposal—and places the patent in the public domain. One might think that the access allocation problem has been solved because the knowledge good is now available to all consumers at zero cost. The problem is that the patented drug is still a long way from market. Before the drug becomes available to consumers, it must go through several expensive clinical trials to demonstrate safety and efficacy in humans.[67] But for-profit firms are unwilling to invest in drug development unless they can, at the very least, recoup their costs.[68] As long as the patent is in the public domain, other firms have the option to free-ride off the efforts of the first firm that invests in commercializing the drug.[69] In sum, the same collective action problem that exists at the knowledge-generation stage may be reproduced at the commercialization stage.

---

65. *See supra* Part I.

66. *See supra* note 4 and accompanying text.

67. *See* Lisa Larrimore Ouellette, *How Many Patents Does It Take to Make a Drug? Follow-on Pharmaceutical Patents and University Licensing*, 17 MICH. TELECOMM. & TECH. L. REV. 299, 302 & nn.10-12 (2010) (citing research and development cost estimates for an approved drug in the range of one hundred million to one billion dollars).

68. *See* Benjamin N. Roin, *Unpatentable Drugs and the Standards of Patentability*, 87 TEX. L. REV. 503, 545-47 (2009).

69. *See* Ian Ayres & Lisa Larrimore Ouellette, *A Market Test for Bayh-Dole Patents*, 102 CORNELL L. REV. 271, 288 (2017) (discussing the "first-commercializer disadvantage"). The first company to shepherd a drug through the FDA approval process does receive a period of patent-like regulatory exclusivity through the FDA, although this added incentive is generally insufficient to spur commercialization absent sufficient patent protection. *See* Lisa Larrimore Ouellette, *Patentable Subject Matter and Nonpatent Innovation Incentives*, 5 U.C. IRVINE L. REV. 1115, 1130-31 (2015) (describing the various exclusivity regimes for general small-molecule drugs, orphan drugs, and biologic drugs); Roin, *supra* note 68, at 566-67 (discussing evidence that these exclusivity periods are inadequate).

To be sure, commercialization involves incentives as well as allocation. The patent for the knowledge that the new compound treats cancer in mice serves to allocate access to this initial knowledge good and to incentivize the production of a follow-on knowledge good, namely, whether the compound also treats cancer in humans. So instead of characterizing this as a non-IP innovation incentive matched with monopoly pricing as an allocation mechanism, we might describe this as the sequential use of non-IP and IP innovation incentives at different junctures in the knowledge-good production process. Our point is simply that even if the initial knowledge good is funded through a non-IP innovation incentive (such as a grant), one still might want to use IP to limit access to this good rather than making it available to all.

The argument made in the previous paragraphs is not a new one. Austrian-American economist Fritz Machlup made a similar point in his now-famous 1958 report to the Senate Judiciary Committee on the patent system:

> The thesis that patent protection is needed as a stimulus to invention has been first supplemented and then replaced by the thesis that it is needed as a stimulus to the practical use of new inventions in industry. Financing the work that leads to the making of an invention may be a relatively small venture compared with that of financing its introduction, because costly development work, experimentation in production and experimentation in marketing may be needed before the commercial exploitation of the invention can begin. The risks involved may be too great to be undertaken except under the shelter of a monopoly grant.[70]

Machlup saw this commercialization rationale as an alternative justification for the patent system. Our analysis unpacks this argument and expands it to other forms of IP, making clear that the commercialization rationale can be a justification for IP as a mechanism for allocating access to an embryonic knowledge good, *not* a justification for IP as an incentive for the initial innovation. That is, the commercialization rationale for IP does not tell us anything about whether IP should be used to spur discovery at an earlier stage of the knowledge-good production process. It would be perfectly consistent with the commercialization rationale to use non-IP innovation incentives (such as prizes, grants, and tax credits) to facilitate the discovery of new drugs, and then to use IP to encourage pharmaceutical firms to commercialize those drugs.

---

70. *See* STAFF OF SUBCOMM. ON PATENTS, TRADEMARKS & COPYRIGHTS OF THE S. COMM. ON THE JUDICIARY, 85TH CONG., AN ECONOMIC REVIEW OF THE PATENT SYSTEM, STUDY NO. 15, at 36-37 (Comm. Print 1958) (prepared by Professor Fritz Machlup); *see also* Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341 (2010) (arguing that traditional patents cannot serve these commercialization goals and proposing a new "commercialization" patent).

To some extent, this is what the Bayh-Dole Act of 1980 does.[71] Before 1980, recipients of federal research grants such as universities faced a patchwork of policies governing whether they could obtain patents on resulting inventions.[72] Bayh-Dole established a uniform rule that government contractors may patent these inventions, and the funding agency may file any patents that the grant recipient chooses not to pursue.[73] The lesser-known Stevenson-Wydler Act of 1980 sets similar rules for research at federal laboratories.[74] If we recall Figure 1, the innovation incentive provided by a federal research grant falls into the upper left-hand box (ex ante, government-set). Yet Bayh-Dole allows universities and other grantees to exercise monopoly power over the resulting innovation—an IP allocation mechanism. To be sure, Bayh-Dole also alters the payoffs for university researchers who produce new knowledge goods, because these researchers can receive some of the profits from university patents. In this respect, as we discuss below,[75] Bayh-Dole leads to the *mixing* of IP and non-IP innovation incentives. But the primary justification for Bayh-Dole has always been the commercialization benefit of exclusive patent rights: the Act matches the non-IP innovation incentive of government grants with an IP-based allocation mechanism so as to ensure that universities will collaborate with industry to bring new knowledge goods to market.[76]

One of us, in work with Ian Ayres,[77] has questioned the case for Bayh-Dole as a mechanism for promoting the commercialization of at least some university-generated knowledge goods. The commercialization rationale rests on the assumption that a firm will invest in bringing university-generated knowledge goods to market only if the university can promise the firm that it will enjoy exclusive rights over the new knowledge good for some time. Yet on average sixty percent or more of university licenses issued each year are nonexclusive,[78] suggesting that at least in many cases, firms do not need the carrot of exclusivity

71. Pub. L. No. 96-517, 94 Stat. 3015 (codified as amended in scattered sections of 35 U.S.C.).

72. *See* Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663, 1671-91 (1996).

73. 35 U.S.C. § 202(a), (c) (2018).

74. 15 U.S.C. §§ 3701-3714 (2018).

75. *See infra* Section III.B.

76. *See* Ayres & Ouellette, *supra* note 69, at 286-90. Bayh-Dole also affects allocation by requiring that licensees manufacture "substantially in the United States" unless domestic manufacture is infeasible. 35 U.S.C. § 204.

77. Ayres & Ouellette, *supra* note 69, at 275-77, 288-90.

78. *See id.* at 275 n.16 (citing *Statistics Access for Technology Transfer (STATT) Database*, ASS'N U. TECH. MANAGERS, https://www.autm.net/resources-surveys/research-reports-databases/statt-database-(1) [https://perma.cc/AL2E-VKWJ]).

in order to invest in commercializing university-generated knowledge goods. In other instances, the commercialization rationale may have greater force. As Mark Lemley has put it, "the validity of commercialization theory depends a great deal on the industry in question and the particular nature of the technology."[79] To distinguish these cases, grant recipients could be required to use a "market test" to solicit information about the importance of exclusivity for commercialization of a given patent.[80] Before exclusively licensing a federally funded invention, grantees could conduct an auction to determine whether any firm will commit to commercializing the invention for less exclusivity. For example, a firm that will take a five-year license would beat another firm that will not invest in the technology without ten years of exclusive rights.[81] In any case, the key point for present purposes is that one can reject the commercialization rationale and still embrace the use of IP at earlier stages of the knowledge-good production process. Alternatively, one can favor non-IP innovation incentives at the outset while adopting the commercialization rationale for IP later on.

In the pharmaceutical context—the primary domain in which Bayh-Dole operates—there is, however, something peculiar about Bayh-Dole's matching of non-IP innovation incentives with IP-based allocation mechanisms. We have argued above that the case for ex ante incentives such as direct spending and refundable tax credits is strongest with respect to capital-intensive projects for which the federal government enjoys an advantage in raising funds. Yet the bulk of the cost of developing a new drug comes at the post-discovery stage—specifically, in clinical trials that are designed to comply with federal FDA regulations.[82] One might think that the federal government would have an advantage over private industry in bringing new pharmaceutical products to market, given its unique ability to raise capital and especially given that the challenge of bringing a new drug to market largely involves navigating *federal* regulations. It is harder to explain why the federal government would enjoy a comparative advantage in choosing projects to finance at the initial drug development stage.

A potential response to the previous point is that market institutions outperform political institutions at selecting promising new drugs for further development and then connecting patients with those new products. As Benjamin Roin

79. Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 611, 622-23 (2008).

80. Ayres & Ouellette, *supra* note 69, at 279-80, 301-16.

81. *Id.* at 301-16.

82. *See* Bruce Booth, *A Billion Here, a Billion There: The Cost of Making a Drug Revisited*, LIFE SCI VC (Nov. 21, 2014), https://lifescivc.com/2014/11/a-billion-here-a-billion-there-the-cost-of-making-a-drug-revisited [https://perma.cc/T9SG-8CUV].

writes, the government "lacks the capacity to reliably develop" new drugs outside the patent system because "it would be unable to identify most of them or complete their preclinical development, has a history of grossly underfunding clinical research, and usually fails to effectively disseminate knowledge of publicly developed therapies to medical practitioners."[83] Roin adds that "[t]he human and technological capital necessary for developing a lead compound into a drug ready for clinical trials and wide-scale production is located almost exclusively in the private sector,"[84] which enjoys an advantage over the government in marketing new products to doctors and patients.[85] This is a valid defense of the current division of labor between government and industry, with the government taking a lead role in financing early-stage development and private-sector firms focusing more often on the post-discovery stage of the process. One might ask, though, whether the existing distribution of capabilities reflects inherent institutional characteristics or path dependency. The government currently lacks the capacity to develop and commercialize new drugs, but that might not mean that the public sector would underperform the private sector on these dimensions if the government committed itself to a more active role in development and commercialization.

In any event, our goal here is not to justify the particular match that Bayh-Dole accomplishes but instead to explain why policy makers might want to match non-IP incentives for initial innovation with IP-based allocation mechanisms at later stages. One such reason, discussed above, is that policy makers prefer an ex ante or government-set incentive for idea generation but believe that exclusive rights over access are necessary for commercialization. A second reason is that policy makers may choose to grant monopoly power to an individual or firm when they worry about the externalities that otherwise might be generated through too-widespread consumption of a new knowledge good.

The field of antibiotics presents a potential application. A number of scholars have suggested that a firm with long-lasting monopoly power over an antibiotic might have an incentive to manage the distribution of the antibiotic so as to minimize the spread of resistance.[86] If overuse of an antibiotic today undermines its

---

83. Roin, *supra* note 68, at 560-61.

84. *Id.* at 562.

85. *See id.* at 563.

86. *See, e.g.*, Eric Kades, *Preserving a Precious Resource: Rationalizing the Use of Antibiotics*, 99 NW. U. L. REV. 611, 643-59 (2005); Ramanan Laxminarayan, *How Broad Should the Scope of Antibiotic Patents Be?*, 84 AM. J. AGRIC. ECON. 1287, 1287-88 (2002); Anup Malani, *Supply-Side Strategies for Tackling Resistance*, *in* EXTENDING THE CURE: POLICY RESPONSES TO THE GROWING THREAT OF ANTIBIOTIC RESISTANCE 133, 141 n.20 (Ramanan Laxminarayan & Anup efficacy down the road, then the profit-maximizing monopolist with a long time horizon might choose to restrict access today in order to ensure that the antibiotic will continue to be useful in the future. Patent lives for antibiotics might be extended beyond the standard twenty-year term so as to motivate monopolists to consider consequences far into the future.[87]

Importantly, this argument for using monopoly power as an allocation mechanism is orthogonal to the choice of innovation incentive for antibiotics. We can imagine an arrangement in which NIH researchers develop an antibiotic and then transfer rights to a firm that manages access so as to minimize resistance. In this scenario, the innovation incentive would be purely ex ante and government-set, while access allocation would be governed by an IP-like monopoly mechanism.[88] We can also imagine a match between a prize for the development of an antibiotic that treats a particular bacterial infection and a government-granted monopoly for the drug postdevelopment. Again, the idea would be to leverage the benefits of government-set rewards while allowing a private party to manage access to the knowledge good.[89]

Malani eds., 2007). *But see* Kevin Outterson, *The Vanishing Public Domain: Antibiotic Resistance, Pharmaceutical Innovation and Intellectual Property Law*, 67 U. PITT. L. REV. 67, 102-19 (2005) (critiquing Eric Kades's proposal and similar suggestions).

87. One might describe this as the access-allocation analogue to Edmund Kitch's prospect theory. *See* Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 267-71 (1977). For another example of how information might decrease in value with use, see William M. Landes & Richard A. Posner, *Indefinitely Renewable Copyright*, 70 U. CHI. L. REV. 471, 487-88 (2003), which argues that if anyone could use Mickey Mouse, then "the value of the character might plummet" because the public would "rapidly tire of" him and "his image would be blurred."

88. Under current law, unlike our hypothetical scenario, the incentive would not be purely ex ante because the NIH researchers would receive a share of the patent royalties (the first $2000 each year and at least fifteen percent thereafter). *See* 15 U.S.C. § 3710c(a)(1)(A)(i) (2018).

89. A somewhat similar example comes from Dean Hamer, a longtime molecular biologist at the NIH, who identified an apparent link between a genetic marker on the X chromosome and homosexuality. *See* Timothy R. Holbrook, *The Expressive Impact of Patents*, 84 WASH. U. L. REV. 573, 587-88 (2006). Hamer was motivated by non-IP innovation incentives – he received an ex ante, government-set reward for his work (an NIH researcher's salary), and he made clear that he had no intention of commercializing his discovery. Indeed, Hamer suggested that by patenting the "gay gene," he could prevent the development of technologies that might test for homosexuality in fetuses. *See* DEAN HAMER & PETER COPELAND, THE SCIENCE OF DESIRE: THE SEARCH FOR THE GAY GENE AND THE BIOLOGY OF BEHAVIOR 219 (1994). As in the antibiotics example, Hamer sought to use IP as a mechanism to limit access to a knowledge good that, if disseminated widely, might cause grave harm. Unlike the antibiotics example, though, little is accomplished through monopoly power here that could not be achieved through an outright ban.

One might ask why policy makers would ever choose monopoly, as opposed to regulation or Pigouvian taxation, as a mechanism for controlling access to a knowledge good when use or overuse is potentially harmful. Under certain circumstances, political-economy considerations supply an answer. Imagine two different proposals for restricting access to an antibiotic: (1) a regime in which the government sets a tax on antibiotics to discourage low-value uses; and (2) a regime in which the government confers a monopoly upon a pharmaceutical company so that the company can allocate access. The first approach lacks a natural constituency: future patients bear the costs of antibiotics overuse, but they might not know today that their future interests are being adversely affected. The second approach, by contrast, enlists as a political ally the pharmaceutical company that stands to profit from monopoly power. In this respect, the case for IP as an allocation mechanism mirrors the argument for using cap-and-trade schemes (with permits distributed to industry incumbents) rather than carbon taxes to control greenhouse gas emissions.[90] The argument is that externality-regulation proposals are easier to pass through a political process when a well-resourced interest group believes that it can extract rents in the event of the proposal's passage.

We also might imagine a similar argument based on the time-inconsistent preferences of policy makers. At the outset, policy makers may recognize that the judicious rationing of access to antibiotics is socially desirable. But when a constituent suffering from a treatable infection demands access to an antibiotic, rejecting that demand may be a political nonstarter even if it is the welfare-maximizing move in the long run. Assigning a monopoly to a private entity may serve as a hands-tying strategy for policy makers who are aware of their own (or their successors') time inconsistency. More generally, IP may prove preferable to marginal-cost pricing as an allocation mechanism when the private sector enjoys an advantage over the government in preserving product effectiveness.[91]

C. Mixing IP and Non-IP Tools

In the previous Section, we considered the possibility of matching an IP-based innovation incentive with a non-IP allocation mechanism, or vice versa. The key point was that IP and non-IP tools can be used on different sides of the

---

90. *See* Nathaniel O. Keohane et al., *The Choice of Regulatory Instruments in Environmental Policy*, 22 HARV. ENVTL. L. REV. 313, 348-51 (1998).

91. *See* Stephen P.A. Brown & William C. Gruben, *Intellectual Property Rights and Product Effectiveness*, FED. RES. BANK DALL. ECON. REV., Fourth Quarter 1997, at 15, 16, 19 (noting that fungicides, herbicides, and pesticides—in addition to antibiotics—are products whose "effectiveness diminishes with cumulative use," and observing that "the case for protecting intellectual property is substantially stronger" with respect to these products).

incentive/allocation divide. Policy makers also can—and often do—mix IP and non-IP tools on the same side of the divide. That is, they can mix IP and non-IP innovation incentives, or IP and non-IP allocation mechanisms. This Section considers when and why policy makers might choose to use such mixed regimes.

1. *Mixing on the Innovation-Incentive Side*

Our analysis of mixing on the innovation-incentive side of the incentive/access divide brings us back again to the taxonomy from Figure 1. First, we consider mixing IP and non-IP mechanisms for *reward setting*. We then consider mixing mechanisms for *reward timing*.

a. *Reward Setting*

Government-set rewards rely on political institutions to estimate the social value of new knowledge goods. Market-set rewards rely, as the name implies, on markets to do the same. Committed socialists and committed libertarians—and certainly everyone in between—can agree that both political institutions and market institutions generate noisy estimates of social value. Under a range of circumstances, the best approach may be to mix the imperfect estimates arising from politics and markets rather than rely on one source only. Indeed, even if we have reason to believe that one estimate is generally superior to the other, mixing the two estimates (with more weight given to the superior estimate) still may make more sense than relying on one alone.

Before turning to why this is so, we should consider what we are trying to estimate. The goal of innovation policy on the incentive side is generally to transfer resources from consumers to producers in amounts large enough to ensure the pursuit of welfare-enhancing research projects. Rational, self-interested producers of knowledge goods will invest only until their *own* marginal benefit equals their marginal cost of production, and they may fail to take into account the benefits that others enjoy from the knowledge goods in question.[92] Governments can facilitate transfers to potential innovators—either enhancing their rewards or reducing their costs—so as to strengthen their incentives to pursue socially beneficial research and development projects. This does not mean that full internalization of benefits is necessary or desirable; a society may choose to allow

92. *See* Hemel & Ouellette, *supra* note 5, at 170 (discussing this phenomenon with respect to nation-state producers of knowledge goods).

(and encourage) some level of spillovers.[93] It does mean that innovation policy will generally aim to enlarge the payoffs for producers of knowledge goods either through market-set rewards (such as patents and tax preferences) or through government-set rewards (such as prizes and grants).

At first glance, patents might appear superior to alternative reward mechanisms because patent rents are closely correlated with social value. Yet there are numerous reasons that the net present value of future monopoly profits may diverge from the social value of a new knowledge good. Perhaps most obviously, the relevant knowledge good may generate positive externalities, such that a consumer's willingness to pay will be less than the good's social value.[94] For example, a consumer who switches from coal power to a new solar-panel technology generates a positive externality (a reduction in carbon emissions and other forms of pollution), but absent a comprehensive system of Pigouvian taxation or cap-and-trade, the consumer is unlikely to capture the full social benefits of her switch. The consumer's willingness to pay is likely to reflect the benefits of the new solar panel technology to *her* but not to the rest of society, and so the price that the patent holder can charge will be less than the full social value. Moreover, we might think that the social value of a knowledge good is greater than potential consumers' ability to pay. For example, an individual with no ability to borrow might have only ten thousand dollars to spend on a life-saving therapy, but most readers likely believe that society should place a higher value on that individual's survival.[95] And as Amy Kapczynski and Talha Syed have emphasized, patent rewards may fail to match social value because of the problem of nonexcludability. For example, the use of checklists dramatically reduced medical errors, and yet the researchers who developed the checklist "technology" cannot capture the full

---

93. *See* Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257 (2007). Furthermore, if the production function for a good is discontinuous, such that a producer is simply deciding whether to invest the fixed costs of a project or not, society needs only to ensure that the producer's private benefits outweigh the private costs. For example, suppose a clinical trial for a new cancer drug will cost $2. And suppose it has a ten percent chance of success, in which case there is a $50 social benefit, but the producer can reap only $10 absent government intervention (making an expected social benefit of $5 and expected private benefit of $1). To ensure that the producer undertakes this welfare-enhancing project, the government need not give the producer the full social benefit—it need only provide either a $1 reduction in cost for a producer who is willing to pursue the project, or a $10 reward if the project is successful.

94. *See* Bronwyn H. Hall & Christian Helmers, *The Role of Patent Protection in (Clean/Green) Technology Transfer*, 26 SANTA CLARA COMPUTER & HIGH TECH. L.J. 487, 489 (2010).

95. *See* Kapczynski, *supra* note 2, at 999-1000.

value of the benefits that their innovation has yielded.[96] Conversely, due to miscalibration or misapplication of patent doctrines, patents may yield rewards that exceed the social value of a knowledge good producer's contribution under certain circumstances.[97]

Just as market-set rewards may undercompensate or overcompensate inventors,[98] government-set rewards like grants and prizes may diverge from social value due to failures of the "political market." Politicians accountable to voters (and other government officials accountable to politicians who are accountable to voters) may favor research projects that pursue headline-grabbing achievements (like a mission to Mars[99] or the discovery of a new fundamental particle[100]) rather than projects with potentially more significant but less salient social benefits (like a reduction in traffic fatalities). Moreover, political processes may

96. *See* Amy Kapczynski & Talha Syed, *The Continuum of Excludability and the Limits of Patents*, 122 YALE L.J. 1900, 1902-03 (2013).

97. *See, e.g.*, Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590, 1603-12 (2011) (explaining why the current "cognitive" approach to patent law's nonobviousness requirement can lead to patents being granted for inventions that would have been created even without the inducement of a patent); Michael D. Frakes & Melissa F. Wasserman, *Does the U.S. Patent and Trademark Office Grant Too Many Bad Patents?: Evidence from a Quasi-Experiment*, 67 STAN. L. REV. 613, 625-31 (2015) (providing evidence of structural biases that cause the Patent and Trademark Office to mistakenly grant invalid patents); William F. Lee & A. Douglas Melamed, *Breaking the Vicious Cycle of Patent Damages*, 101 CORNELL L. REV. 385 (2016) (arguing that patent damages awards often overcompensate patentees).

98. The prior paragraph focused on failures in patent rewards, but R&D tax credits—in tandem with non-IP forms of market power—provide a similar market-based reward, which may in some cases be closer to the socially optimal transfer than patent rents. *See* Hemel & Ouellette, *supra* note 4, at 330-31.

99. For one front-page story, see Kenneth Chang, *Mars Shows Signs of Having Flowing Water, Possible Niches for Life, NASA Says*, N.Y. TIMES (Sept. 28, 2015), https://www.nytimes.com/2015/09/29/science/space/mars-life-liquid-water.html [https://perma.cc/T9ZE-75DT].

100. Even the *failure* of scientists at the European Organization for Nuclear Research (CERN)'s Large Hadron Collider to discover a new elementary particle can make the *New York Times*. *See* Dennis Overbye, *The Particle that Wasn't*, N.Y. TIMES (Aug. 5, 2016), https://www.nytimes.com/2016/08/05/science/cern-large-hadron-collider-particle.html [https://perma.cc/D5VN-K29Z]. The cost of the Large Hadron Collider has been well over $10 billion. *See* Alex Knapp, *How Much Does It Cost to Find a Higgs Boson?*, FORBES (July 5, 2012), https://www.forbes.com/sites/alexknapp/2012/07/05/how-much-does-it-cost-to-find-a-higgs-boson [https://perma.cc/7C4Y-CG5Y].

be subject to corruption[101] or captured by well-organized and well-resourced interest groups whose own objectives diverge from those of society at large.[102] Even entirely well-meaning government officials may fail to adjust reward size to reflect social value because the information necessary to estimate social value with accuracy is widely dispersed, difficult to compile, and ever evolving.[103]

If the estimates of social value generated by markets and governments are perfectly correlated with each other, then mixing would be unlikely to accomplish all that much. If, however, the estimation errors are not perfectly correlated, then setting rewards based on a mix of market-generated and government-generated estimates might give us more confidence in our estimate of social value than either estimate on its own. We might prefer, for instance, a scenario like the status quo in which patents last twenty years and the federal government spends more than one hundred billion dollars a year on research and development rather than a scenario in which patents last forty years and the federal government spends nothing on research. (Likewise, we might prefer the current combination over a scenario in which there are no patents but the federal government spends two hundred billion dollars a year on research.[104]) The idea would be that a system that sets rewards for innovation based on a mix of market and governmental estimates may be likely to stray less drastically in either the overcompensatory or undercompensatory direction relative to social value.[105]

---

101. *See* Lily Fang et al., *Corruption, Government Subsidies, and Innovation: Evidence from China* (Nat'l Bureau of Econ. Research, Working Paper No. 25098, 2018), https://www.nber.org/papers/w25098.pdf [https://perma.cc/FS94-CBCH] (finding evidence of corruption-driven distortions of government R&D subsidies in China).

102. *See, e.g.*, Deepak Hegde & Bhaven Sampat, *Can Private Money Buy Public Science? Disease Group Lobbying and Federal Funding for Biomedical Research*, 61 MGMT. SCI. 2281 (2015); Rick Cohen, *Universities Pay Plenty for Influence and Access Through Lobbying*, NONPROFIT Q. (July 16, 2014), https://nonprofitquarterly.org/2014/07/16/universities-pay-plenty-for-influence-and-access-through-lobbying [https://perma.cc/XCK6-LU4Z].

103. *See* Demsetz, *supra* note 35, at 19-20.

104. The net present value of monopoly rents over a forty-year patent term may be less than two times the net present value of monopoly rents over a twenty-year patent term if the discount rate is positive. Conversely, rents over the forty-year patent term may be *more than* twice as valuable—even on a discounted cash flow basis—if the relevant invention is characterized by a long time-to-market such that much of the twenty-year patent period is consumed by clinical trials. *See* Benjamin N. Roin, *The Case for Tailoring Patent Awards Based on Time-to-Market*, 61 UCLA L. REV. 672, 727-30 (2014).

105. This idea will be familiar to scholars of tax and public finance. *See* Brian Galle, *Carrots, Sticks, and Salience*, 67 TAX L. REV. 53, 78 (2013) ("The deadweight loss of each distortion bears an exponential relationship to the size of the distortion. That means that the total loss from two small distortions of size *X* will be much less than the lost utility caused by a single distortion of size 2*X*." (footnote omitted)).

There are numerous situations in which mixing noisy estimates—perhaps with heavier weighting of the more accurate measure—leads to a better overall estimate. As an example familiar to lawyers and law students, LSAT score and undergraduate GPA are highly imperfect predictors of 1L GPA individually, but combining the estimates leads to a better overall predictor.[106] Readers who follow the medical literature may know that statistical meta-analysis, which combines results from separate studies (such as different clinical trials or observational studies of a drug's efficacy), is frequently used to obtain a better estimate of the underlying truth.[107] Similarly, setting reward size based on some combination of both the market-generated estimate and the political market-generated estimate of likely social value may lead to less divergence from a knowledge good's true social value than setting reward size based only on one of those two estimates.

Of course, mixing will not always yield a more accurate estimate. If undergraduate grades were assigned at random, then predictions of 1L GPA based on LSAT score and undergraduate GPA would be no better than predictions based on LSAT score alone. Even if the additional predictor marginally improves the accuracy of the blended estimate, the administrative costs may still not be worth the increase in predictive power. For example, if predictions based on undergraduate GPA alone performed almost as well as predictions based on LSAT score and undergraduate GPA, then the cost of administering, taking, and relying on the LSAT (for the law schools that are members of LSAC and for students themselves) might not be worth the nearly trivial benefits. Moreover, blending estimates entails the additional administrative cost of determining the optimal blend. One might still favor innovation policy monism over pluralism on administrative-cost grounds, since multiple systems are more expensive to maintain and evaluate than one.

Our claim here focuses only on whether a given state-facilitated transfer to knowledge-good producers is better distributed through a single policy instrument or multiple policy instruments. One might be concerned, however, that having multiple policy instruments available would in practice inevitably in-

---

106. *See* Lisa C. Anthony et al., *Predictive Validity of the LSAT: A National Summary of the 2011 and 2012 LSAT Correlation Studies*, LAW SCH. ADMISSION COUNCIL 9 tbl.2 (2013), https://www.lsac.org/docs/default-source/research-%28lsac-resources%29/tr-13-03.pdf [https://perma.cc/9BVU-X7AC]. For an excellent overview and reanalysis of law school outcome predictors, see Alexia Brunet Marks & Scott A. Moss, *What Predicts Law Student Success? A Longitudinal Study Correlating Law Student Applicant Data and Law School Outcomes*, 13 J. EMPIRICAL LEGAL STUD. 205 (2016).

107. *See* MICHAEL BORENSTEIN ET AL., INTRODUCTION TO META-ANALYSIS, at xxiv (2009).

crease the overall reward as multiple instruments are stacked without any reduction to account for the others. If, as some argue, the patent system already confers excessive rewards upon innovators,[108] then adding government-set rewards on top of that might make the problem even worse. This stacking concern is real—providing a too-rich incentive leads to unnecessary deadweight loss, whether from the above-marginal-cost prices on patented products or from taxation.[109] Furthermore, it is possible that the combination of two incentives could decrease the efficacy of either individually—if, for example, the monetary incentive from patents "crowds out" the motivation of grant-funded researchers to pursue basic research with the highest social value.[110]

One potential solution to these concerns would be to limit innovators to the maximum reward provided by any one system, such as by reducing patent rewards to account for nonpatent incentives.[111] Note, however, that if government-set rewards are targeted toward knowledge goods that the market underestimates, then reducing the market-generated reward for these knowledge goods may be counterproductive. For example, if the value of a patent reward R_{patent} were reduced for goods that received grant funding by the value of the grant R_{grant} (which can only be done if $R_{\text{patent}} > R_{\text{grant}}$), then the total reward for such goods would simply be the patent reward: $R_{\text{total}} = R_{\text{grant}} + (R_{\text{patent}} - R_{\text{grant}}) = R_{\text{patent}}$. The value of the grant would only be relevant when it is larger than the patent reward ($R_{\text{grant}} > R_{\text{patent}}$) such that the modified patent reward would be zero and $R_{\text{total}} = R_{\text{grant}}$. The ultimate reward thus would be the larger of the patent reward and the grant reward: $R_{\text{total}} = max(R_{\text{patent}}, R_{\text{grant}})$. That would, in effect, be like treating the applicant with a strong LSAT score and a similarly strong undergraduate GPA no more favorably than an applicant with the same LSAT score and a D average as an undergraduate. Doing so would discard much of the information that undergraduate GPA can convey.

Further, even if patent rents are perfectly correlated with social value, they are likely to be systematically less than social value. This is because unless the patent holder can price discriminate perfectly (charging different prices to different buyers), the prices charged to consumers will be less than most consumers' willingness to pay. Imagine three consumers, *A*, *B*, and *C*, who value a knowledge good *X* at \$3, \$2, and \$1, respectively. Assume, for simplicity, that the

108. *See, e.g.*, Lee & Melamed, *supra* note 97.

109. *See generally* Hemel & Ouellette, *supra* note 4, at 314-15 (discussing these costs).

110. *See* BENKLER, *supra* note 1, at 92-97. We have previously explained why it is difficult to make generalizable claims about social-psychological rewards given that they are mutable and culturally contingent. Hemel & Ouellette, *supra* note 4, at 352-55.

111. *See* Ouellette, *supra* note 16.

marginal cost of manufacturing a product that embodies *X* is zero. Unless the patent holder has some way to charge different prices to *A* and *B*, the profit-maximizing strategy is to charge \$2—in which case *A* and *B* will buy the good and *C* will refrain, resulting in revenues of \$4.[112] Yet the total social value of the new knowledge good is \$5 (the sum of the \$3 value to *A* and the \$2 value to *B*). The patent holder captures only a portion (though in this case a large portion) of the value created by their good.

Why might policy makers care that patent holders do not capture the full social value of their innovations? Imagine that a potential innovator is deciding whether to pursue a project that, if successful, will yield a knowledge good for which the market is as described for good *X*. Let's say, moreover, that the cost of pursuing the project is \$1.01 and the chance of success is one in four. If the potential innovator knows that she can capture only \$4 in monopoly rents if successful, then she will rationally decline to pursue the project ($0.25 \times \$4 < \$1.01$). While an omnipotent social planner would direct the potential innovator to pursue the project, the incentive generated by patent protection won't do the trick on its own. This problem cannot be solved by uniformly increasing patent rewards across the board, because the size of the mismatch depends on the elasticity of demand and on the patent holder's ability to price discriminate (both of which vary across different knowledge goods).[113]

To be sure, many projects still will be pursued even if potential innovators cannot fully internalize the benefits. Under those circumstances, full internalization of benefits may have the undesirable consequence of increasing deadweight loss.[114] Our point is simply that even if patent rents are perfectly correlated with social value, policy makers may have reason to increase the total incentives beyond those provided by patent protection alone. One way to do so is by using tax preferences—a non-IP mechanism—to enhance patent rents. Imagine, again, that the cost of pursuing a project is \$1.01 and that the chance of success is one in four. Let's also say that the after-tax monopoly rents in the event of success are \$4 and that before-tax rents are \$5 (due to a tax rate of 20%).[115] Now imagine that the government implements a "patent box"—a regime under which patent

112. Or perhaps the patent holder will charge \$1.99, so that *B* just ever so slightly prefers buying the good over not buying, and the resulting revenues will be $\$1.99 \times 2 = \$3.98$.

113. Furthermore, as noted above, patent rents are *not* perfectly correlated with social value—even aside from patentees' inability to perfectly price discriminate, they may over- or undervalue inventions—so any uniform shift in patent rewards would exacerbate other error costs. *See supra* notes 94-97 and accompanying text.

114. *See supra* note 93 and accompanying text.

115. We will assume, to keep the arithmetic as straightforward as possible, that the cost of pursuing the project is nondeductible.

income is taxed at a lower rate than other income.[116] If the patent box rate is 10%, then the after-tax monopoly rents rise from $4 to $4.50, and the expected value of the inventor's payoffs rises to $1.125, which exceeds the $1.01 cost of pursuing the project.[117] Tax preferences for patent rents can leverage information generated by market institutions to push potential innovators over the margin between not pursuing and pursuing socially beneficial projects.

In sum, there may be good reasons to mix IP and non-IP mechanisms for reward setting. One reason is that market institutions and political institutions generate different and often noisy estimates of the social value of knowledge goods. Combining the two estimates may yield a more accurate estimate of social value than relying on one alone, though one must weigh this potential benefit against the administrative costs of the additional incentive system. Mixing also might be attractive when patent rents are undercompensatory, in which case amping up patent rewards through tax preferences might be desirable. Under these circumstances, IP and non-IP rewards would not be duplicative: reliance on both types of mechanisms would yield policy outcomes preferable to what could be achieved using either alone.

b. *Reward Timing*

Mixing innovation incentives with different reward timings may yield additional benefits by preserving some of the motivational value of ex post rewards while also delivering a subsidy earlier in time. Consider a capital-intensive R&D effort in a field in which the government enjoys a comparative advantage in assessing potential projects (space exploration, for example).[118] Policy makers might favor an ex ante reward so that researchers do not have to devote significant time and effort to arranging financing;[119] but they also might worry that an

---

116. Patent boxes have become increasingly popular in Europe and are being debated in the United States. *See* Michael J. Graetz & Rachael Doud, *Technological Innovation, International Competition, and the Challenges of International Income Taxation*, 113 COLUM. L. REV. 347, 362-75 (2013); Peter R. Merrill et al., *Is It Time for the United States to Consider a Patent Box?*, 134 TAX NOTES 1665 (2012).

117. For the sake of simplicity, we assume risk neutrality. On attitudes toward risk among innovators and the implications for IP, see *supra* note 27 and accompanying text.

118. *See* Hemel & Ouellette, *supra* note 4, at 375-76.

119. This is not to imply that applying for grants or tax credits is costless; for an overview of their administrative costs, see *id.* at 362-64. Conceivably, the costs of applying for grants or filing for tax credits could exceed the costs of arranging private-sector financing through venture capital or securities markets, though this will depend on the details of the grant application or tax credit qualification process and the specific characteristics of the relevant capital markets.

up-front grant with no ex post reward would fail to motivate researchers to work expeditiously—after all, if researchers have the grant money already, then what's the rush?[120] In this situation, policy makers might choose to provide a grant ex ante while also dangling the prospect of a prize ex post if researchers achieve certain milestones by specific dates.[121]

Efforts to study the effects of increased ex post financial incentives in controlled laboratory experiments have yielded ambiguous results (with higher incentives *hurting* mean performance in some cases).[122] Even those experiments finding that higher incentives increased performance have not shown increases commensurate with higher ex post rewards.[123] These results may cast doubt on the wisdom of adding an ex post reward to an ex ante grant in every instance. Nonetheless, we see mixing of ex ante and ex post rewards for innovation across a wide range of real-world settings, suggesting either that laboratory results do not accurately reflect reality or that sophisticated commercial actors misapprehend the relationship between performance and reward. Consider the popular inclusion of stock options in the compensation packages of employees at Silicon Valley tech firms.[124] When an employee is paid in cash and in stock options, she receives a real-time reward for her labor (cash) plus an ex post reward that is at least loosely linked to performance (options). The link between performance

---

120. In practice, direct spending can be structured to provide an incentive to finish the work on time, such as by withholding the final payment until delivery of some project or report, but this simply shifts the policy along our vertical reward-timing axis, with the corresponding tradeoffs between ex ante and ex post rewards.

121. Alternatively, policy makers could use an ex post stick to penalize firms that fail to develop new knowledge goods or fall short of specific targets. *See* Ian Ayres & Amy Kapczynski, *Innovation Sticks: The Limited Case for Penalizing Failures to Innovate*, 82 U. CHI. L. REV. 1781 (2015).

122. *See* Colin F. Camerer & Robin M. Hogarth, *The Effects of Financial Incentives in Experiments: A Review and Capital-Labor-Production Framework*, 19 J. RISK & UNCERTAINTY 7, 21-22 (1999) (reviewing seventy-four such experiments).

123. *Id.* at 21 ("[W]hile adding some incentive to otherwise-hypothetical choices often matters, experiments which then multiply stakes by 2, 4, or 20 do not produce similar boosts in performance.").

124. *See* Richard Harroch, *How Employee Stock Options Work in Startup Companies*, FORBES (Feb. 27, 2016, 10:32 AM), https://www.forbes.com/sites/allbusiness/2016/02/27/how-employee-stock-options-work-in-startup-companies [https://perma.cc/4JFE-XS6A] ("The spectacular success of Silicon Valley companies and the resulting economic riches of employees who held stock options have made Stock Option Plans a powerful motivational tool for employees to work for the company's long-term success."). On the use of options at Google (now Alphabet), see Katie Hafner, *Google Options Put Masseuse in Crowd of Multimillionaires*, N.Y. TIMES (Nov. 12, 2007), https://www.nytimes.com/2007/11/12/technology/12iht-12google.8292343.html [https://perma.cc/CU2C-8NJT]; and Cade Metz, *Alphabet Could Give Google Employees More (Stock) Options*, WIRED (Aug. 11, 2015, 4:23 PM), https://www.wired.com/2015/08/alphabet-give-google-employees-stock-options [https://perma.cc/FW62-5RWZ].

and reward is closer for firms with fewer employees, and it can be tightened further through the use of bonuses that tie employees' payoffs to their own performance, rather than options that tie payoffs to company-wide performance.

Why don't we see Silicon Valley firms paying their employees entirely on the basis of performance? This is no puzzle. First, payment for performance must be ex post, and many employees are liquidity constrained and limited in their ability to borrow to finance current consumption.[125] Alternatively, many experience "debt aversion" that discourages them from borrowing even when they can.[126] These individuals might prefer real-time payment over an ex post reward even when the expected dollar value of the ex post reward is greater. Second, potential employees may be risk averse and therefore prefer the certainty of a real-time payment over the unpredictability of an ex post, performance-based reward. Again, the firm can sweeten its compensation offer (from the potential employee's perspective) while reducing its expected cost (from its own perspective) by paying a real-time wage that is decoupled from performance.

At the same time, the firm may not want to sacrifice the incentive effects of ex post performance pay entirely. Under these circumstances, a compensation package that combines a real-time, risk-free component and an ex post, performance-contingent component may be optimal.[127] One way to explain this result is to assume that the employee values the first bit of real-time, risk-free pay more than the last. By moving from 0% of compensation being a real-time, risk-free payment to 10%, the firm sweetens the pay package from the perspective of the risk-averse employee more than it does by moving from 90% to 100%. Each such shift sacrifices some of the motivational force associated with ex post, performance-based pay, but the 0% to 10% shift increases the overall attractiveness of the compensation offer (and thus draws higher quality employees) more than the 90% to 100% shift might.

---

125. In theory, a capital-rich firm—or government—could provide payment for good performance ex ante and then demand repayment if the researcher is not successful, effectively acting as a private financier. But for this to work, the researcher would need to hold sufficient capital to repay the loan in the event of failure (thus raising the same issue of liquidity constraints) or would need to buy private insurance against the risk of failure (thus raising the same issue of transaction costs). In either case, the researcher still would be exposed to significant financial risk (thus raising the same issue of risk aversion). And if the researcher lacked sufficient capital to repay the loan and went without insurance, then the arrangement would not be true "performance pay" because the firm or government would have no way to recoup the upfront payment in the event of failure.

126. *See, e.g.*, Thomas Meissner, *Intertemporal Consumption and Debt Aversion: An Experimental Study*, 19 EXPERIMENTAL ECON. 281 (2016).

127. *See generally* Bengt Holmstrom & Paul Milgrom, *Aggregation and Linearity in the Provision of Intertemporal Incentives*, 55 ECONOMETRICA 303 (1987) (deriving the optimal compensation scheme for a risk-averse agent who increases effort in response to performance incentives).

Mixing ex ante and ex post rewards at the level of economy-wide innovation policy follows the same logic that leads to mixing at the firm level in the employee-compensation context. If potential innovators are constrained by credit or averse to debt or risk, they may value the immediacy and certainty of an ex ante reward (such as a grant or an immediately refundable tax credit). And if the prospect of an ex post reward exerts a motivational force on innovators, then society may have an interest in delaying rewards and linking them to performance. The combination of ex ante and ex post rewards represents an effort to achieve the best of both worlds. While we do not claim that mixing ex ante and ex post rewards is always optimal, we think there are strong reasons to expect that some combination of ex ante funding and ex post rewards will dominate pure ex ante or pure ex post approaches in at least some cases.

2. *Mixing on the Allocation Side*

Allocation mechanisms specify the number (n) of individuals and firms with the right to supply (or license) the relevant knowledge good. The most familiar allocation mechanisms are monopoly ($n = 1$) and open access ($n = \infty$).[128] As noted above, however, one can imagine intermediate arrangements in which $1 < n < \infty$.[129] One can also imagine an allocation mechanism in which $n = 0$ (i.e., the relevant knowledge good is banned). For example, it is generally unlawful to possess or transfer chemical weapons,[130] and U.S. patents related to national security may be kept secret and limited to government use.[131] In addition to specifying the number of authorized suppliers, allocation mechanisms also can in-

128. In practice, n will never really be infinity due to barriers to entry, but competitive pricing does not require infinite firms in a market. Also note that "monopoly" need not entail IP rights. As a theoretical matter, it does not matter whether the supercompetitive price is imposed by a private firm or by the government through a targeted sales tax on particular products. As we have previously explained, above-marginal-cost pricing is a necessary feature of any innovation policy that imposes costs only on users of the knowledge goods, rather than having all taxpayers cross-subsidize each other's knowledge-good consumption. Hemel & Ouellette, *supra* note 4, at 349-50.

129. *See supra* notes 36, 44 and accompanying text.

130. *See* 18 U.S.C. § 229(a)(1) (2018).

131. *See* 35 U.S.C. §§ 181-188 (2018). Inventions related to national security may also be an example, like antibiotics, in which an IP allocation strategy helps prevent too-widespread consumption of a new knowledge good. *See supra* notes 86-89 and accompanying text.

corporate taxes on—or subsidies of—knowledge goods, resulting in after-tax, after-subsidy prices above the monopoly price or below marginal cost.[132]

The standard argument for open access is that marginal-cost pricing maximizes allocative efficiency (i.e., eliminates deadweight loss).[133] Returning to our example of consumers *A*, *B*, and *C* who value a knowledge good *X* at $3, $2, and $1 respectively, we may note that an open-access mechanism means that all three consumers will have access to the knowledge good, resulting in a social surplus of $6. Recall that a monopoly price of $2 would cause consumer *C* to forego purchasing the good, resulting in social surplus of only $5. More generally, if the marginal cost of supplying the knowledge good to an additional consumer is $0, then (setting aside the possibility of price discrimination[134]) the price that maximizes allocative efficiency is $0.

There are, however, at least two distinct reasons why we might want to set prices for knowledge goods above $0—in other words, why we might want to set $n < \infty$—and thereby allow a certain amount of supracompetitive pricing. The first reason is informational: some amount of proprietary pricing can generate useful information regarding the social value of an invention, feeding back on the appropriate incentive. The second reason is distributional: under certain circumstances and for certain goods, we might think that an allocation mechanism that is at least partly "user pays" is normatively desirable.[135]

We start with the informational rationale. One advantage of monopoly pricing is that the social value of a new knowledge good is otherwise difficult, if not

132. On the economics of government subsidies in a monopoly market, see Douglas Gary Lichtman, *Pricing Prozac: Why the Government Should Subsidize the Purchase of Patented Pharmaceuticals*, 11 HARV. J.L. & TECH. 123 (1997).

133. *See, e.g.*, Amy Kapczynski, *Intellectual Property's Leviathan*, 77 LAW & CONTEMP. PROBS. 131, 133 (2014) (noting that "[i]nformation . . . has a marginal cost of zero, which in economic parlance means that for efficient uptake, it should be priced only at its cost of distribution" and that exclusion rights create "deadweight loss [and] . . . [d]ynamic inefficiencies").

134. Partial price discrimination is, in fact, prevalent in the U.S. pharmaceutical market, with pharmaceutical manufacturers charging lower prices to Veterans Affairs hospitals and Medicaid providers and charging markups for brand-name drugs over generics. *See* Ernst R. Berndt & Joseph P. Newhouse, *Pricing and Reimbursement in US Pharmaceutical Markets*, *in* THE OXFORD HANDBOOK OF THE ECONOMICS OF THE BIOPHARMACEUTICAL INDUSTRY 201, 231-37 (Patricia M. Danzon & Sean Nicholson eds., 2012).

135. A third reason is derivative of the negative-externalities argument for mixing non-IP innovation incentives with IP allocation mechanisms. *See supra* notes 86-90 and accompanying text. Policy makers might decide that access restrictions are desirable due to the negative externalities of widespread use but that the access limitations that would result from full monopoly are undesirably severe.

impossible, to determine.[136] The government might look to the number of consumers who use a particular knowledge good and compensate the producer accordingly, but quantity is an imperfect measure of social value. As economists Glen Weyl and Jean Tirole note, a new innovation can capture a large share of the market but add little social value if it amounts to only an incremental improvement over its predecessor.[137] If, however, a patent holder can charge a high price for a product, then that is evidence that consumers assign a high value to the product relative to substitutes. Thus, an allocation mechanism involving above-marginal-cost pricing generates additional information regarding social value, which policy makers can then use in setting the size of the innovation incentive. As Weyl and Tirole put it, proprietary pricing serves a "screening" function, allowing policy makers to distinguish revolutionary innovations from incremental ones.[138]

But the informational benefits of higher prices come with a cost: the loss of the allocative efficiency of an open-access mechanism. The challenge for policy makers is to strike a balance between benefits and costs. Weyl and Tirole argue that pure monopoly and pure open access are never optimal—the welfare-maximizing solution always lies somewhere in the intermediate range.[139] Motivating Weyl and Tirole's argument is the intuition that the first bit of market power increases deadweight loss only trivially, while the last bit of market power (moving from near monopoly to full monopoly) yields only trivial informational benefits. That is, marginal deadweight loss increases with each additional increment of market power, while marginal informational benefit decreases. The optimal arrangement entails an interior solution, not a corner solution.

How might an interior solution—somewhere between open access and monopoly pricing—be achieved in practice? One possibility is to grant monopoly power to patentees but also offer a partial subsidy for consumers. The net purchase price after subtracting the subsidy would be somewhere between marginal

136. As noted above, at least some IP is needed on the allocation side for some knowledge goods if the innovation incentive is to provide an IP-like, market-set reward. *See supra* note 64 and accompanying text.

137. E. Glen Weyl & Jean Tirole, *Market Power Screens Willingness-to-Pay*, 127 Q.J. ECON. 1971, 1972-75 (2012). Weyl and Tirole offer the example of "Netscape Navigator during the 1990s, which, though widely adopted, sold at a low price because it offered little added value over its rivals." *Id.* at 1972.

138. *Id.* at 1974. This analysis does not require that market-set rewards are uniformly superior to government-set rewards—only that the information provided by this market-based screening function is useful in setting the optimal reward. On mixing noisy estimates, see *supra* note 105 and accompanying text.

139. Weyl & Tirole, *supra* note 137, at 1974-76.

cost (zero) and the profit-maximizing price that a monopolist would choose in an unsubsidized setting.[140] A more intricate version of mixing might involve an arrangement like that proposed by Ayres and Klemperer, where patentees are entitled to duopoly profits rather than monopoly profits.[141] Because duopoly pricing screens willingness to pay (though not quite as effectively as monopoly pricing), the government can then use the duopoly profit as an estimate of social value. But because social value will exceed the duopoly profit (by even more than social value exceeds the monopoly profit), the government might then magnify the resulting innovation incentive with a patent box.

This proposal could be extended from duopoly to oligopoly pricing, and if a patent box with a reduced rate of tax is insufficient to compensate the patentee, then the patent box could in theory entail a negative rate of tax (i.e., the patentee's after-tax income would exceed her pretax income). Alternatively, the government could supplement the payoff to innovators by mixing IP and non-IP incentives. These intermediate allocation solutions avoid the full deadweight loss of monopoly pricing while still generating some informational benefits.

This is not to say that mixed allocation regimes are necessarily superior to pure monopoly and pure open access for all knowledge goods under all circumstances. One might acknowledge the desirability of mixing in theory but oppose it in practice based on administrative cost concerns; after all, two access regimes are more expensive to implement, evaluate, and police than one.[142] One might also oppose any deviation from the open-access model for knowledge goods on ethical grounds. Consider, for example, John Willinsky's argument that "[a] commitment to the value and quality of research carries with it a responsibility to extend the circulation of such work as far as possible and ideally to all who are interested in it and all who might profit by it."[143]

Alternatively, different distributional principles might weigh against mixing any subsidies into allocative policy. For example, suppose that the government can accurately estimate the social value of some new knowledge good. This would seem to suggest that the optimal allocation mechanism is one of open access because there is no information to be gained from proprietary pricing. The

---

140. *Id.* at 1992-93.

141. Ayres & Klemperer, *supra* note 44, at 1031-32.

142. Any of the above examples of mixed allocation regimes would entail the usual administrative costs of the patent system (including the costs of initial examination and of subsequent litigation) plus the costs of administering a subsidy, patent box, auction, or other policy.

143. JOHN WILLINSKY, THE ACCESS PRINCIPLE: THE CASE FOR OPEN ACCESS TO RESEARCH AND SCHOLARSHIP, at xii (2006) (emphasis omitted).

government can minimize deadweight loss through non-IP innovation incentives such as prizes, grants, or tax credits, and it can set the size of the reward correctly without relying on observed willingness to pay. But consider a case where the relevant knowledge good is a luxury product consumed primarily by the wealthy. Why, one might fairly ask, should lower- and middle-income taxpayers bear any portion of the cost of, say, a new yachting technology?[144] Even though the knowledge good may be socially beneficial, the benefit accrues to a segment of society that is not ordinarily thought to be the proper beneficiary of government redistribution. Since the government has only finite resources, the allocative-efficiency benefits of open access must be weighed against the distributional consequences of using public funds to pay for advances that benefit only the rich. Under these circumstances, policy makers might decide that they still want to rely on a user-pays model to some degree, though perhaps not entirely.

To be sure, an alternative approach might be to combine a non-IP innovation incentive and an open-access allocation mechanism with adjustments to the tax-and-transfer system that offset the distributional consequences of the subsidy for luxury goods. Yet if there are insuperable political obstacles to tax-and-transfer reform,[145] then policy makers might decide that the best available option is one in which users pay some, if not all, of the cost of the innovator's reward.

In sum, for informational as well as distributional reasons, policy makers might prefer intermediate allocation solutions over pure monopoly ($n = 1$) and pure open access ($n = \infty$). Monopoly and open access do not exhaust the set of possible allocation regimes; indeed, they barely scratch the surface. Policy makers facing a diverse set of challenges may thus have good reasons for adopting mixed allocation mechanisms that entail some amount of proprietary pricing short of full monopoly.

D. Layering IP and Non-IP Systems

We have already seen that policy makers can match IP-based innovation incentives with non-IP allocation mechanisms (and vice versa), and that they can

---

144. On technological innovations in yachting, see Antonio Regalado, *Steve Jobs Lives on at the Patent Office*, MIT TECH. REV. (Nov. 27, 2014), https://www.technologyreview.com/s/532841/steve-jobs-lives-on-at-the-patent-office [https://perma.cc/TN9N-LVGA]; and *With This Patent Does Steve Jobs Own the Future of Yacht Navigation?*, OCEAN NEWS (Sept. 22, 2014), https://www.oceanofnews.com/steve-jobs-yacht [https://perma.cc/EM4Y-VBW3].

145. *See generally* Lee Anne Fennell & Richard H. McAdams, *The Distributive Deficit in Law and Economics*, 100 MINN. L. REV. 1051 (2016) (challenging the assumption that the undesirable distributional effects of "welfare-maximizing" policies can always be offset through tax-and-transfer adjustments).

mix IP and non-IP tools on either side of the incentive/allocation divide. But that does not exhaust the possibilities of innovation policy pluralism. Another important option is to use different innovation policies at different jurisdictional levels. Most notably, policy makers can use non-IP incentives and allocation mechanisms domestically while using the international IP framework globally—that is, to *layer* IP at the supranational level and non-IP or hybrid regimes at the national level.[146] Countries can also layer supranational non-IP regimes with national IP law, but international IP law is the primary, though not exclusive,[147] innovation policy employed at the supranational level.

All members of the World Trade Organization (164 nations in total) are bound by the 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which requires all but the least-developed nations to protect the IP rights of all TRIPS members at or above a basic level.[148] For example, TRIPS members must offer twenty-year patents in "all fields of technology" to inventors in any member country, including for novel pharmaceuticals and food products that some countries had previously excluded from patentability.[149] TRIPS is a significant step in the longer trend of IP standards gradually being "revised upwards to require greater and different protection" through international agreements.[150]

---

146. Camilla Hrdy notes that as a descriptive and normatively desirable matter, state and local governments often offer subsidies to local innovators who can then seek patent protection on a national scale. *See* Camilla A. Hrdy, *Patent Nationally, Innovate Locally*, 31 BERKELEY TECH. L.J. 1301 (2017). Our argument moves this dynamic up one level: national governments often offer subsidies to domestic innovators who can then seek patent protection on an international scale.

147. On multinational and transnational efforts employing non-IP innovation incentives, see Hemel & Ouellette, *supra* note 5, at 231-32. Examples include the International Space Station, CERN, and the Global Influenza Surveillance and Response System. *See id.*

148. Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, 1869 U.N.T.S. 299 [hereinafter TRIPS]; *see Members and Observers*, WORLD TRADE ORG. (July 29, 2016), https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm [https://perma.cc/VL8T-P4VV]; *Responding to Least Developed Countries' Special Needs in Intellectual Property*, WORLD TRADE ORG. (Oct. 16, 2013), https://www.wto.org/english/tratop_e/trips_e/ldc_e.htm [https://perma.cc/ZC5S-HQ7C].

149. TRIPS art. 27(1), *supra* note 148, at 311. For example, prior to TRIPS, India excluded patents on "substances intended for use, or capable of being used, as food or as medicine or drug." Amy Kapczynski, *Harmonization and Its Discontents: A Case Study of TRIPS Implementation in India's Pharmaceutical Sector*, 97 CALIF. L. REV. 1571, 1576 & n.21 (2009) (quoting Patents Act, No. 39 of 1970, INDIA CODE § 5 (2005), vol. 15).

150. Graeme B. Dinwoodie, *The Architecture of the International Intellectual Property System*, 77 CHI.-KENT L. REV. 993, 995 (2002).

But we think many IP scholars have overlooked the point that this international framework and domestic IP policy are largely separable. Even the strongest international IP regime does not lead ineluctably to the use of IP-based innovation incentives or allocation mechanisms at the domestic level.[151] On the incentives side, countries can still comply with TRIPS while using non-IP tools to encourage domestic innovation. For example, a country could provide incentives only though grants and prizes conditioned on relinquishing IP rights, while the national government itself retains revenues from licensing the knowledge good in other countries. Or—as is more common—countries can both subsidize the domestic production of knowledge goods through grants and tax credits and purchase domestic patent rights from the producer, while still allowing the producer to collect overseas profits (with the state potentially collecting some of those profits through a tax on the domestic producer).[152]

On the allocation side, countries can (and often do) choose nonprice mechanisms—closer to open access than to proprietary pricing—to distribute knowledge goods at the domestic level. For instance, a country that wants to make a patented pharmaceutical available to its own citizens at zero or marginal cost can purchase a license from the patentee and pay for the license using funds raised through broad-based taxation. Countries with single-payer health care systems generally follow a version of this model, respecting the patentee's IP rights while avoiding domestic deadweight loss from proprietary pricing.[153] Even countries without single-payer health care, such as the United States, often

151. Our discussion here and in the following paragraph draws from Hemel & Ouellette, *supra* note 5, at 173-74.

152. For an explanation of how Bayh-Dole regimes can help countries internalize foreign benefits of domestic R&D spending, see Daniel J. Hemel & Lisa Larrimore Ouellette, *Bayh-Dole Beyond Borders*, 4 J.L. & BIOSCIENCES 282 (2017).

153. Countries' autonomy to use alternative allocation tools will be limited, however, if their investments can be dispersed to consumers in other countries through international resale markets. The Supreme Court recently changed the U.S. rules such that foreign sales now exhaust U.S. patents and copyrights. *See* Impression Prods. v. Lexmark Int'l, Inc., 137 S. Ct. 1523 (2017); Kirtsaeng v. John Wiley & Sons, Inc., 568 U.S. 519 (2013). As we explain in a separate essay, exhaustion of international IP rights undermines a key benefit of the current international IP system. Daniel J. Hemel & Lisa Larrimore Ouellette, *Trade and Tradeoffs: The Case of International Patent Exhaustion*, 116 COLUM. L. REV. SIDEBAR 17 (2016). It may be possible, however, to recapture some of these benefits through contractual restrictions. *See* Daniel Hemel & Lisa Larrimore Ouellette, *Licensing in the Shadow of* Impression Products, MEDIUM: WHATEVER SOURCE DERIVED (May 31, 2017), https://medium.com/whatever-source-derived/licensing-in-the-shadow-of-impression-products-with-lisa-larrimore-ouellette-9bbf8c350c65 [https://perma.cc/H6WV-MJV6].

allocate access to patented pharmaceutical products through nonmarket mechanisms (e.g., the Medicaid program).[154]

We have argued that rather than dictating domestic policy, the role of international IP law is to provide a serviceable (if imperfect) framework for cost sharing among countries that produce and consume knowledge goods. Without such a framework, certain goods for which demand transcends national boundaries would be underproduced.[155] Absent an international cost-sharing mechanism, rational and self-interested countries will finance knowledge goods only up to the point that the marginal cost equals the marginal benefit to their own citizens, rather than the marginal benefit to all people everywhere.[156] International IP law addresses this underinvestment problem by ensuring that when Country *A* produces a knowledge good that benefits consumers in Country *B*, Country *B* will provide at least some compensation to Country *A*. As a general matter, TRIPS prohibits Country *B* from using the Country-*A*-produced knowledge good without first reaching some sort of cost-sharing agreement with Country *A* (such as a license from the private producer in Country *A*, who may be separately subsidized or taxed by Country *A*'s government). In this respect, TRIPS functions as an "agreement to agree": signatory states commit to reaching an arrangement under which knowledge-good consumers share costs with knowledge-good producers. The agreement to agree operates against the background rule that absent a further arrangement, the consumer state cannot use the knowledge

154. The allocation-only aspect of programs such as Medicaid leaves room for policy makers to tailor innovation incentives without fundamentally altering the consumer experience. *See generally* Rachel E. Sachs, *Prizing Insurance: Prescription Drug Insurance as Innovation Incentive*, 30 HARV. J.L. & TECH. 153 (2016) (discussing how Medicaid could be modified to more deliberately incentivize innovation).

155. As we emphasize in earlier work, not all knowledge goods are "global public goods"; for some, demand is primarily domestic. *See* Hemel & Ouellette, *supra* note 5, at 170 n.13. And in some cases, demand for a knowledge good may cross borders, but the good addresses a problem so important to a single country that the country's government will invest quite heavily (though perhaps still suboptimally) even without any cross-border cost-sharing mechanism—e.g., flood control technology in the Netherlands. *See* Andrew Higgins, *Lessons for U.S. from a Flood-Prone Land*, N.Y. TIMES (Nov. 14, 2012), https://www.nytimes.com/2012/11/15/world/europe/netherlands-sets-model-of-flood-prevention.html [https://perma.cc/MX27-8P2F] (discussing Dutch preeminence in flood-related research).

156. Our prediction that states will underinvest in the provision of global public goods relies on a model of states as rational egoists; other accounts of state behavior may generate divergent predictions. *See* Hemel & Ouellette, *supra* note 5, at 201-14 (drawing from the international political economy literature and discussing realist, constructivist, and public choice models of state behavior).

good for which the producer state (or one of its citizens or firms) holds a patent.[157]

While cost-sharing through TRIPS can address the global underinvestment problem, international IP law is not the only possible cost-sharing framework. We can imagine a global prize fund or a global R&D organization, financed by mandatory national contributions, that would also provide for cost sharing among producer and consumer states. Yet international IP law has the advantage of establishing a link between the benefits to the consumer country and the size of the transfer from the consumer country to the producer country. Under international IP law, no country ever needs to pay for knowledge goods it doesn't use. No such assurance would exist with respect to a global prize fund or global R&D organization. Such an institution might channel more of its funding to "first-world problems" than to problems facing less-developed nations. (Indeed, if wealthier nations control the institutional levers of power, then this prediction seems not just plausible but likely.[158])

Importantly, the argument for using international IP law as a cross-border cost-sharing mechanism does not depend on whether individual countries use IP to incentivize innovation or allocate access to knowledge goods at the domestic level. International and domestic innovation policy choices are separable. So too, countries can be innovation policy pluralists at the domestic level even while the international regime is exclusively IP-oriented. One might call this "second-order innovation policy pluralism": a mix of pluralism at one level and monism

157. This is true as a general matter but not universally: Article 30 of TRIPS allows a signatory state to "provide limited exceptions" to patent rights, and Article 31 allows compulsory licensing of a patent for "adequate remuneration . . . taking into account the economic value of the authorization." TRIPS arts. 30-31, *supra* note 148, at 312-14. Except in cases of "national emergency," "circumstances of extreme urgency," or "cases of public non-commercial use," a signatory state must make "efforts to obtain authorization from the right holder on reasonable commercial terms" before it can make unauthorized use of the patent. *Id.* art. 31(b). From January 1995 to June 2011, there were twenty-four instances in which countries threatened to issue compulsory licenses for pharmaceuticals, most of which ended in either compulsory licenses or voluntary price reductions. Reed Beall & Randall Kuhn, *Trends in Compulsory Licensing of Pharmaceuticals Since the Doha Declaration: A Database Analysis*, PLOS MED., Jan. 2012, at 1, 4 tbl.1. Note also that countries retain substantial autonomy in how they define the substantive standards of patent protection and in how much they allow patent rights to be cabined by related bodies of law such as antitrust. *See generally* GRAEME B. DINWOODIE & ROCHELLE C. DREYFUSS, A NEOFEDERALIST VISION OF TRIPS: THE RESILIENCE OF THE INTERNATIONAL INTELLECTUAL PROPERTY REGIME (2012) (describing these flexibilities).

158. Hemel & Ouellette, *supra* note 5, at 242.

at another.[159] The key point is that innovation policy choices at the international level need not dictate decisions at the national level, or vice versa.

III. INNOVATION POLICY PLURALISM IN PRACTICE: THE CASE OF PHARMACEUTICALS

So far, we have explained why policy makers might choose to match, mix, and layer IP and non-IP innovation incentives and allocation mechanisms. In this Part, we seek to show that innovation policy pluralism not only offers a normatively desirable approach under a wide range of circumstances but also provides a descriptively accurate account of the world in which we live, and thus a useful analytic language for describing the real world of innovation policy. We focus on the pharmaceutical industry, the so-called poster child for the patent system.[160] We argue that the pharmaceutical industry is instead a poster child for innovation policy pluralism, with matching, mixing, and layering aplenty.

To be clear, our intent is not to provide a detailed account of the many complicated legal regimes governing pharmaceutical innovation. There are numerous policy levers beyond patents through which drug manufacturers can maintain IP-like exclusivity, including regulatory exclusivity through the FDA,[161] trade secrecy,[162] and trademarks.[163] Our goal is to show how these various IP, IP-like, and non-IP tools are collectively matched, mixed, and layered within an even richer set of innovation policy possibilities to promote socially desirable outcomes.

---

159. *Cf.* Heather K. Gerken, *Second-Order Diversity*, 118 HARV. L. REV. 1099, 1108 (2005) ("Second-order diversity seeks variation *among* decisionmaking bodies, not *within* them. It favors *inter*organizational diversity, not *intra*organizational diversity. Thus, whatever the axis of difference (race, gender, political affiliation), second-order diversity describes a system in which at least some decisionmaking bodies look nothing like the population from which they are drawn.").

160. *See supra* note 6 and accompanying text.

161. *See* Rebecca S. Eisenberg, *The Role of the FDA in Innovation Policy*, 13 MICH. TELECOMM. & TECH. L. REV. 345 (2007); Yaniv Heled, *Regulatory Competitive Shelters*, 76 OHIO ST. L.J. 299 (2015).

162. *See* W. Nicholson Price II, *Expired Patents, Trade Secrets, and Stymied Competition*, 92 NOTRE DAME L. REV. 1611 (2017); W. Nicholson Price II & Arti K. Rai, *Manufacturing Barriers to Biologics Competition and Innovation*, 101 IOWA L. REV. 1023 (2016).

163. *See* Dipak C. Jain & James G. Conley, *Patent Expiry and Pharmaceutical Market Opportunities at the Nexus of Pricing and Innovation Policy*, *in* INNOVATION AND MARKETING IN THE PHARMACEUTICAL INDUSTRY 255, 263 (Min Ding et al. eds., 2014); Jason S. George & Lisa Larrimore Ouellette, Trademarks as Innovation Incentives (May 28, 2018) (unpublished manuscript) (on file with authors).

Section III.A focuses on the matching of IP innovation incentives and non-IP allocation mechanisms, and vice versa, in the market for pharmaceuticals. Section III.B turns to examples of mixing on either side of the incentive/allocation divide. Section III.C brings in the international context, demonstrating that countries use non-IP or hybrid regimes at the domestic level while relying on international IP law to share the costs of innovation across borders.

A. Matching in Practice

The prototypical "match" of an IP innovation incentive and a non-IP allocation mechanism involves the government purchasing a patent on a knowledge good for a market-determined price and then putting the knowledge good in the public domain. But while actual transfers of patents from rights-holders to governments are "rare,"[164] government purchases of patented products from rights-holders are not.

The closest thing to a large-scale patent buyout scheme in the United States is the Medicaid program, which covers almost twenty percent of the U.S. population.[165] In 2014 alone, Medicaid purchased twenty-two billion dollars of prescription drugs from pharmaceutical firms.[166] The prices paid by Medicaid are based on market rates; a system of rebates ensures that Medicaid pays no more than the lowest price at which the drug is sold to other consumers.[167] The Medicaid program, which is administered jointly by the federal government and the states, then distributes drugs to patients for free or at a deeply discounted cost.[168]

---

164. Isabelle Liotard & Valérie Revest, *Contests as Innovation Policy Instruments: Lessons from the US Federal Agencies' Experience*, 127 TECH. FORECASTING & SOC. CHANGE 57, 59 (2018).

165. *Health Insurance Coverage of the Total Population: 2016*, HENRY J. KAISER FAM. FOUND. (Jan. 27, 2018), https://www.kff.org/other/state-indicator/total-population [https://perma.cc/42S3-E8LD]. Medicare Part D, discussed at further length in Section III.B, can also be considered a match between the patent system as an innovation incentive and an allocation mechanism that is partly but not purely IP-based.

166. *See* David Blumenthal & David Squires, *Drug Price Control: How Some Government Programs Do It*, COMMONWEALTH FUND: POINT (May 10, 2016), https://www.commonwealthfund.org/publications/blog/2016/may/drug-price-control-how-some-government-programs-do-it [https://perma.cc/GH6X-AZDW].

167. *See id.* Alternatively, the rebate system ensures that Medicaid pays 23.1% of the average price charged for patented drugs—13% for generic drugs—if that amount is lower than the lowest price charged to another consumer. *See* 42 U.S.C. § 1396r-8(c) (2018); Sachs, *supra* note 154, at 196.

168. For children and pregnant women below certain income levels, drugs provided through Medicaid are free. For all patients below 150% of the federal poverty line, the maximum payment for prescription drugs is eight dollars. *See* Samantha Artiga et al., *The Effects of Premiums and Cost Sharing on Low-Income Populations: Updated Review of Research Findings*, HENRY J. KAISER

From the pharmaceutical firm's perspective, the payoff remains based on an ex post, market-generated estimate of social value—although the federal government's inability to negotiate drug prices potentially results in a higher market-based reward than the firm would have received if consumers were paying out of pocket.[169] From the perspective of at least some patients,[170] the allocation mechanism approximates an open-access regime. In countries with single-payer health care systems that extend to prescription drugs, matching occurs to an even greater extent because virtually all drugs are allocated through a mechanism other than monopoly pricing.[171]

Matching in the opposite direction is also common in the pharmaceutical space. As discussed above,[172] the primary rationale for the Bayh-Dole Act is that monopoly power will encourage commercialization of knowledge goods *after* the initial discovery. The payoff structure for grant-funded research scientists is largely (though not exclusively) ex ante and government-set; IP serves to allocate access at the next stage. A significant share of the pharmaceutical industry's output is a result of this sort of matching. Bhaven Sampat and Frank Lichtenberg found that between 1988 and 2005, nine percent of all new drugs approved by the FDA—and more than seventeen percent of "priority-review drugs," which are generally the most innovative new medicines—had patents held either by a

FAM. FOUND. 3 tbl.1 (June 2017), https://files.kff.org/attachment/Issue-Brief-The-Effects-of-Premiums-and-Cost-Sharing-on-Low-Income-Populations [https://perma.cc/HKG9-EPAN].

169. The minimum a government purchaser must pay for a patented drug will be set by the profit that the patentee could earn on the private market, whereas the maximum will depend on factors such as the purchaser's and patentee's relative bargaining power. The United States, unlike most other developed nations, lacks a government mechanism for negotiating prescription drug prices. *See* NAT'L ACADS. OF SCI., MAKING MEDICINES AFFORDABLE: A NATIONAL IMPERATIVE 82 (Norman R. Augustine et al. eds., 2018). By increasing the pharmaceutical innovator's reward beyond what it would earn on the private market, the federal government is really moving beyond a market-set reward to provide an additional innovation incentive for biomedical research. *See* Sachs, *supra* note 154, at 185-92.

170. To be sure, an eight-dollar copay may be prohibitively expensive for some very low-income patients. *See* Artiga et al., *supra* note 168, at 4-5. The key point is that for all Medicaid patients, access to prescription drugs is not allocated through the mechanism of monopoly pricing, and for some patients, access is free.

171. This does not mean that pharmaceuticals are allocated on an open-access basis in countries with single-payer systems. Access may be rationed through nonmarket mechanisms. *See* Richard Vize, *Rationing Care Is a Fact of Life for the NHS*, GUARDIAN (Apr. 24, 2015), https://www.theguardian.com/healthcare-network/2015/apr/24/rationing-care-fact-of-life-nhs [https://perma.cc/W9LD-KB3D].

172. *See supra* note 76 and accompanying text.

government agency or a government-funded laboratory (typically in academia).[173] Additionally, citation data suggest that government funding played at least an indirect role in the development of almost two-thirds of FDA-approved priority-review drugs during that time period.[174]

In sum, a large swath of the market for pharmaceuticals in the United States involves two scenarios. Either (a) the government purchases patented products from the private sector and then distributes those products to patients for free or at deeply discounted prices, or (b) the government develops new drugs in-house or at federally financed laboratories and then allows firms to allocate access through proprietary pricing mechanisms. These two matches are not mutually exclusive—in many cases Medicaid will purchase a pharmaceutical product that was initially developed in a government or government-funded lab, bringing the government's role in the innovation and allocation process full circle. The key point for now is that the pharmaceutical sector in the United States should not be seen as relying purely on IP either as an innovation incentive or as a mechanism for allocating access; a fair amount of matching between IP and non-IP innovation incentives and allocation mechanisms occurs in this sector.

B. Mixing in Practice

Next, we turn to instances in which IP and non-IP tools are used on the same side of the innovation/allocation divide. Again, the Bayh-Dole Act proves illustrative. Defenders of Bayh-Dole emphasize the Act's commercialization benefits—the way it allocates access to publicly funded knowledge goods to promote efficient use, as discussed above.[175] But another way in which Bayh-Dole shapes the innovation landscape is by changing the payoff structure for government-funded scientists and their employers. The opportunity to reap large monetary rewards from patent licensing potentially leads government-funded researchers to pursue different projects from those that they would have tackled absent the

173. Bhaven N. Sampat & Frank R. Lichtenberg, *What Are the Respective Roles of the Public and Private Sectors in Pharmaceutical Innovation?*, 30 HEALTH AFF. 332, 334-35 (2011).

174. *See id.* at 335. Note that not all government funding that leads to FDA-approved drugs flows through academic labs or academic-industry partnerships; the government also directly funds industry research. *See, e.g.*, *Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR)*, NAT'L INSTITUTES HEALTH, https://sbir.nih.gov [https://perma.cc/ZS5Y-DJVE].

175. *See supra* notes 71-76, 172-174 and accompanying text.

Bayh-Dole Act.[176] The consequence is that researchers at government and government-funded labs may be responsive not only to politically generated estimates of social value but to market estimates as well.[177] In this respect, the Bayh-Dole Act mixes non-IP and IP tools on the innovation side of the innovation/allocation divide.

The desirability of mixing IP and non-IP incentives in this context is debatable. In favor of mixing, one might argue that market incentives motivate government-funded scientists to increase their research effort, especially with respect to potential innovations that have valuable real-world applications.[178] Against mixing, one might argue that market incentives have encouraged scientists to pursue projects with the greatest commercial potential rather than the greatest social value—and have diverted scientists away from the basic research efforts that might lead to groundbreaking advances.[179] The existing empirical literature does not support firm conclusions, though there is some evidence to suggest that the introduction of market incentives into the mix is salutary. For example, Pierre Azoulay, Waverly Ding, and Toby Stuart, in a study of nearly four thousand academic life scientists over three decades, found that scientists

---

176. *See* Pierre Azoulay, Waverly Ding & Toby Stuart, *The Impact of Academic Patenting on the Rate, Quality, and Direction of (Public) Research Output*, 57 J. INDUS. ECON. 637, 668 (2009) (suggesting that patenting tends to increase the rate of publication and "may also modestly shift the content of these publications toward questions of commercial interest").

177. Some scholars have found that giving university researchers a larger share of patent royalties leads to higher license income or patenting rates. *See* Nicola Baldini, *Do Royalties Really Foster University Patenting Activity? An Answer from Italy*, 30 TECHNOVATION 109, 114 (2010); Saul Lach & Mark Schankerman, *Incentives and Invention in Universities*, 39 RAND J. ECON. 403, 427-28 (2008); Hans K. Hvide & Benjamin F. Jones, *University Innovation and the Professor's Privilege* (Nat'l Bureau of Econ. Research, Working Paper No. 22057, 2016). But other scholars, including one of us, have not found evidence of this effect. *See* Pere Arqué-Castells et al., *How Inventor Royalty Shares Affect Patenting and Income in Portugal and Spain* (IEB, Working Paper No. 2015/14, 2015), https://ssrn.com/abstract=2585080; Lisa Larrimore Ouellette & Andrew Tutt, How Do Patent Incentives Affect University Researchers? (Jan. 27, 2018) (unpublished manuscript) (on file with authors).

178. *See* Marie Thursby, Jerry Thursby & Swasti Gupta-Mukherjee, *Are There Real Effects of Licensing on Academic Research? A Life Cycle View*, 63 J. ECON. BEHAV. & ORG. 577, 596 (2007) (concluding that opportunities for scientists to profit from the commercialization of inventions potentially lead to higher research output and a larger stock of knowledge, so long as "the applied effort involved in licensing leads to publishable output as well as licenses").

179. *See, e.g.*, Janet Rae-Dupree, *When Academia Puts Profit Ahead of Wonder*, N.Y. TIMES (Sept. 6, 2008), https://www.nytimes.com/2008/09/07/technology/07unbox.html [https://perma.cc/JV9Q-EWDG]; *cf.* BENKLER, *supra* note 1, at 92-99 (suggesting that financial incentives may lead to less innovation if they "crowd out" intrinsic rewards). For a discussion of how Bayh-Dole has affected academic norms, see Arti K. Rai & Rebecca S. Eisenberg, *Bayh-Dole Reform and the Progress of Biomedicine*, 66 LAW & CONTEMP. PROBS. 289 (2003).

who engaged in more patenting activity also published more than otherwise equivalent nonpatenters and that their papers were published in journals with marginally higher impact factors.[180] This suggests that market incentives do not divert scientists from other valuable research endeavors.

We do not seek to resolve this debate here. Instead, we make two modest claims. First, as a theoretical matter, the addition of ex post, market-set rewards to the mix of incentives can have positive effects on innovation under a range of circumstances, either by providing additional motivation for researchers or by encouraging researchers to pursue projects that the political market has undervalued. Second, in practice, the Bayh-Dole Act adds an ex post, market-set reward to the payoff structure for federally funded researchers in the United States. Given the important role of government funding and Bayh-Dole patents in the U.S. pharmaceutical industry,[181] it is accurate to say that mixing of IP and non-IP innovation incentives is a common occurrence across that sector.

Mixing of IP and non-IP policies in the pharmaceutical space also occurs on the allocation side of the innovation/access divide. The most prominent U.S. example is the federal Medicare Part D program. Enrollees in standard Medicare Part D plans pay a portion—but not all—of prescription drug costs after a $405 deductible.[182] The result is that, for enrollees in Medicare Part D plans, access to prescription drugs is not entirely determined by monopoly pricing, but it is not entirely open access either. Instead, the partial subsidy gives rise to a system in which access is allocated through a mix of market power and government assistance.

There is little evidence to suggest that Medicare Part D's mixing of allocation mechanisms was the result of a high-minded effort by lawmakers to harness the

180. Azoulay, Ding & Stuart, *supra* note 176, at 651-52, 667, 670. Note that while patenters and nonpatenters have different publication trends before the initiation of patenting, the authors account for self-selection into patenting on the basis of observable characteristics, including lagged productivity and the latent patentability of a scientist's research trajectory. *Id.* at 639. For other studies reaching similar conclusions, see, for example, Kira R. Fabrizio & Alberto Di Minin, *Commercializing the Laboratory: Faculty Patenting and the Open Science Environment*, 37 RES. POL'Y 914, 929 (2008); Brent Goldfarb, Gerald Marschke & Amy Smith, *Scholarship and Inventive Activity in the University: Complements or Substitutes?*, 18 ECON. INNOVATION & NEW TECH. 743 (2009); and Jerry G. Thursby & Marie C. Thursby, *Has the Bayh-Dole Act Compromised Basic Research?*, 40 RES. POL'Y 1077, 1081-83 (2011).

181. *See supra* notes 173-174 and accompanying text.

182. The cost-sharing formula is complicated, but in brief: most enrollees pay 25% of costs up to $3,750 per year, 35% to 44% of costs from there until they hit an $8,418 "catastrophic coverage threshold" for the year, and 5% of costs above the catastrophic coverage threshold. *See The Medicare Part D Prescription Drug Benefit*, HENRY J. KAISER FAM. FOUND. 2-3 (Oct. 2, 2017), https://files.kff.org/attachment/Fact-Sheet-The-Medicare-Part-D-Prescription-Drug-Benefit [https://perma.cc/M7SP-PN54].

informational benefits of proprietary pricing while mitigating the attendant allocative inefficiencies. Instead, budgetary constraints and political compromise shaped the program, which was signed into law by President George W. Bush in 2003.[183] A perhaps unintended consequence, however, is that Medicare Part D offers an interior solution of the sort suggested by Weyl and Tirole: patients and prescribers reveal some information about how much they value particular drugs through their purchasing behavior, but the partial subsidy reduces the deadweight loss of monopoly pricing.[184]

In any event, whatever the wisdom of Medicare Part D's approach, the program's centrality to the U.S. pharmaceutical market is undeniable. Nearly forty-one million Medicare beneficiaries are now enrolled in Part D plans,[185] and more than thirty percent of all prescription drug spending in the United States is via Part D.[186] For a very large swath of the population, pharmaceutical drugs are allocated neither fully on the basis of proprietary pricing nor through open access, but instead through a mix of IP and non-IP mechanisms.

C. Layering in Practice

In Section II.D we suggested that international IP law could serve as a mechanism for sharing the costs of knowledge production across borders even when countries rely on non-IP innovation incentives or allocation mechanisms internally. Here, we seek to show that notwithstanding the hybridity of domestic innovation policy, the United States and other countries continue to use IP to allocate knowledge production costs among countries.

---

183. *See* Thomas R. Oliver et al., *A Political History of Medicare and Prescription Drug Coverage*, 82 MILBANK Q. 283, 309-16 (2004).

184. *See supra* notes 137-140 and accompanying text.

185. Jack Hoadley et al., *Medicare Part D in 2016 and Trends over Time*, HENRY J. KAISER FAM. FOUND. 4 (Sept. 2016), https://files.kff.org/attachment/Report-Medicare-Part-D-in-2016-and-Trends-over-Time [https://perma.cc/AEH7-MQYH].

186. *See* Lacie Glover, *Here's How Much We Spent on Prescription Drugs Last Year*, MONEY (June 2, 2015), https://time.com/money/3904386/prescription-drugs-costs [https://perma.cc/U4FN-UWM6] (reporting that $374 billion in prescription drug spending in 2014 represented a 13.1% increase from the previous year); Katie Thomas & Robert Pear, *Medicare Releases Detailed Data on Prescription Drug Spending*, N.Y. TIMES (Apr. 30, 2015), https://www.nytimes.com/2015/05/01/business/medicare-releases-detailed-data-on-prescription-drug-spending.html [https://perma.cc/WBN2-32F8] (reporting $103 billion in spending on prescription drugs through Medicare Part D in 2013).

Our evidence comes from original data analysis regarding patent filings by United States universities from 2000 to 2011.[187] During that period, U.S. universities filed 36,943 patent families—groups of patents protecting a single invention—at the U.S. Patent and Trademark Office (PTO), nearly thirty-six percent of which were also filed at the European Patent Office. United States universities also frequently filed patent families in Canada, Japan, Australia, China, and South Korea.[188] Scientists at these universities encounter a payoff structure that includes non-IP innovation incentives (in the form of government grants) as well as IP-based incentives (in the form of potential profits from Bayh-Dole patents). At the domestic level, the patent system allocates access to their innovations through pure non-IP mechanisms (e.g., Medicaid) and through mixed IP and non-IP mechanisms (e.g., Medicare Part D).

Despite this mixing and matching of domestic innovation incentives and allocation mechanisms with respect to knowledge goods produced at U.S. universities, IP dominates the global picture. That is, U.S. universities and their licensees use international IP law to extract payments from other countries that use U.S.-generated knowledge goods. (As noted above, it is irrelevant to our analysis whether the payments are made directly to the U.S. government or to private firms within the U.S. that can be separately taxed by the U.S. government.[189]) Those foreign countries may themselves allocate access internally through non-IP mechanisms such as single-payer health care systems. Interestingly, we see very low filing rates in less affluent countries, somewhat allaying concerns about global distributive justice. Indeed, only 0.1% of patent families filed by United States universities at the PTO were also filed in countries that the World Bank classifies as "lower-income economies."[190] International IP law thus serves primarily to reallocate the costs of knowledge production among high- and middle-income countries.

---

187. We report our findings in Hemel & Ouellette, *supra* note 152, at 301-05.

188. Not all filings by U.S. universities reflect pharmaceutical patents, but Bayh-Dole licensing activity has been focused primarily on pharmaceutical and other life-science innovations. *See* Charles R. McManis & Sucheol Noh, *The Impact of the Bayh-Dole Act on Genetic Research and Development: Evaluating the Arguments and Empirical Evidence to Date*, *in* PERSPECTIVES ON COMMERCIALIZING INNOVATION 435, 437 n.5 (F. Scott Kieff & Troy A. Paredes eds., 2011) (citing data from the Association of University Technology Managers indicating that seventy percent of active Bayh-Dole licenses are in the life sciences). Moreover, not all U.S. university research is federally funded, but a majority of it is. *See* Hemel & Ouellette, *supra* note 152, at 283 n.10.

189. *See supra* Section II.D.

190. Hemel & Ouellette, *supra* note 152, at 305 tbl.1.

In sum, the pharmaceutical industry, domestically and globally, provides examples of widespread matching, mixing, and layering in practice. Characterizations of the pharmaceutical industry as a paradigm of the patent system overlook the multiple and overlapping innovation policy regimes that drive innovation and allocate access to vital treatments. Patent law's poster child presents us with a potentially fruitful environment in which to investigate innovation policy pluralism's real-world successes and shortcomings.

IV. MATCHING, MIXING, AND LAYERING BEYOND PATENTS

Thus far, we have illustrated our framework using examples drawn primarily from the world of patents and patent alternatives.[191] But our distinction between innovation incentives and allocation mechanisms, as well as our discussion of matching, mixing, and layering, can inform and be informed by debates beyond patent law. Section IV.A considers the utility of our approach for other areas of intellectual property law that can cover less technical knowledge goods—chiefly copyright and, more tentatively, trademark. Section IV.B reflects upon the relationship between innovation policy debates and parallel conversations in the law of real and personal property. We conclude that certain aspects of our approach are specific to the production and allocation of knowledge goods that historically have enjoyed patent protection, while other elements extend well beyond the knowledge-good domain.

A. IP Beyond Patents

Perhaps the most straightforward application of our framework is to the production and allocation of creative works—film, fine art, literature, music, and so on. Here, as in patent law, intellectual property protection is simultaneously justified on the ground that it incentivizes creation and criticized on the ground that it generates allocative inefficiencies.[192] Again, as with patent-protected knowledge goods, the market-based innovation incentive offered by copyright law needs not bring with it the full deadweight loss of proprietary pricing. The matching strategies described above—such as second-price auctions for IP rights resulting in government buyouts in a subset of cases—could be cross-applied to

191. As noted above, we treat patents as akin to other exclusivity mechanisms such as trade secrets and FDA-administered regulatory exclusivity. *See supra* notes 18, 161-163 and accompanying text.

192. *See, e.g.*, Twentieth Century Music Corp. v. Aiken, 422 U.S. 151, 156 (1975) (noting that copyright law "reflects a balance of competing claims upon the public interest"—on the one hand, "stimulat[ing] artistic creativity," while on the other hand, "promoting broad public availability of literature, music, and the other arts").

creative works as well. For instance, authors might put new novels up for auction, with publishers bidding for exclusive rights; then in $1 - p$ cases, the government would swoop in and buy the novel at the second-highest price, thereafter placing the work in the public domain. This is but one example of the many possible allocation and innovation schemes that exist beyond traditional IP.

The advantages of such an arrangement for creative works—a match between an IP innovation incentive and a non-IP allocation mechanism—are in some respects even greater than the virtues of similar matches in the context of historically patent-protected knowledge goods. First, whatever unease we might have with the notion of the government picking and choosing which R&D projects to pursue in a field such as biotechnology, our unease is likely many times greater when we contemplate the government picking and choosing which novels to write or which films to shoot. The case for market-set rather than government-set rewards in the creative space seems strong enough on comparative-competency grounds (do we think that the government can identify—and would finance—the next coming of *The Underground Railroad*[193] or *Black Panther*?[194]). And even if the government could anticipate the next winner of the Pulitzer Prize for fiction or the next box office sensation, concerns about free expression and democratic discourse might lead us to reject such direct government involvement in the production of art and thought. On the allocation side, meanwhile, the problems with proprietary pricing may be even more acute with respect to creative works than with, say, new pharmaceutical products. Creative works are in many cases *antirivalrous*: the fact that you and I have read the same novel or watched the same film potentially *enhances* the enjoyment of the experience for both of us.[195] Under these conditions, the socially optimal allocation policy arguably entails a negative price (i.e., a subsidy) rather than simply free access. Proprietary pricing may be even further from the ideal in this context than in other areas.

In scattered circumstances, we observe variants of a match between an IP innovation incentive and a non-IP allocation mechanism for creative works. Perhaps the most obvious example is public libraries, which spend over one billion dollars of taxpayer money each year purchasing copies of books and other copy-

---

193. COLSON WHITEHEAD, THE UNDERGROUND RAILROAD (2016).

194. BLACK PANTHER (Marvel Studios 2018).

195. Consider, for example, the pleasure you derive from discussing a favorite novel with a friend who has read the same work, or from being able to drop allusions to a popular sitcom in conversations without having to explain the joke, or from debating the twist ending of a detective series among colleagues without having to broadcast a spoiler alert to all within earshot.

righted works, sometimes at a steep discount but other times at close to the market price,[196] and then providing free access to those copies.[197] Public museums, such as the National Gallery and the museums within the Smithsonian Institution, do the same for works of fine art. In other cases, federal, state, and local governments directly or indirectly subsidize nongovernmental institutions that purchase or lease copyrighted works and make those works accessible to the public at low or no cost. For example, the Metropolitan Museum of Art in New York has received approximately $28 million per year, almost 8% of the museum's total funding, from the City of New York in recent years.[198] The City of Chicago imposes a property surtax that partially funds several of the city's leading art museums.[199] Approximately 41% of public television revenues and 16% of public radio revenues come from a combination of federal, state, and local government support.[200] On top of all this, the federal income tax deduction for charitable contributions operates as a subsidy for gifts to museums, performing-arts organizations, and other entities that make creative works available to the public for free or at reduced cost.[201]

Locating some of these expenditures on the innovation-incentive or allocation-mechanism side of the incentive/allocation divide exposes the potential permeability of the separation between the two. Should we think about the federal subsidy for public radio as an innovation incentive that encourages the production of shows such as WBEZ's *This American Life* or as an allocation mechanism that makes shows like *This American Life* available to listeners for free? Tracing

196. *See The Disappearing Library Discount*, AM. LIBR.: E-CONTENT (Feb. 4, 2013), https://americanlibrariesmagazine.org/blogs/e-content/the-disappearing-library-discount [https://perma.cc/ZW32-CLRV].

197. *See* Lea Shaver, *The Right to Read*, 54 COLUM. J. TRANSNAT'L L. 1, 34 (2015).

198. *See One Hundred Forty-Seventh Annual Report of the Trustees for the Fiscal Year July 1, 2016, Through June 30, 2017*, METROPOLITAN MUSEUM ART 85 (Nov. 14, 2017), https://www.metmuseum.org/-/media/Files/About%20The%20Met/Annual%20Reports/2016-2017/Annual%20Report%202016-17.pdf [https://perma.cc/4A6G-ZXPS].

199. *See 2018 Chicago Park Budget Summary*, CHI. PARK DISTRICT 47 (2018), https://www.chicagoparkdistrict.com/sites/default/files/documents/departments/budget/2018-budget-summary1.pdf [https://perma.cc/W83A-H9L6].

200. *See Alternative Sources of Funding for Public Broadcasting Stations*, CORP. FOR PUB. BROADCASTING 17-18 (June 20, 2012), https://www.cpb.org/files/aboutcpb/Alternative_Sources_of_Funding_for_Public_Broadcasting_Stations.pdf [https://perma.cc/3K5B-R6TH].

201. The Joint Committee on Taxation does not break out a separate estimate for the tax expenditure associated with charitable contributions that subsidize dissemination of creative works. The expenditure associated with the deduction for charitable contributions other than for education and health was approximately $45 billion in 2017. *See* STAFF OF THE JOINT COMM. ON TAXATION, JCX-3-17, ESTIMATES OF FEDERAL TAX EXPENDITURES FOR FISCAL YEARS 2016-2020, at 37 (2017).

the flow of federal funds (do government dollars go toward production or toward dissemination?) is only partly informative: money is fungible, so funds that offset WBEZ's broadcasting costs allow WBEZ to shift resources toward the making of shows. The distinction between innovation incentives and allocation mechanisms—through crisp in some circumstances—becomes blurrier when we imagine the government subsidizing organizations that both produce new content and distribute that content for free or at discounted prices.

What about matches in the opposite direction—the use of non-IP tools to bring about the production of creative works coupled with IP as an allocation mechanism? In the United States, the federal government has explicitly disclaimed copyright protection for government-created works such as statutes, codes, judicial opinions, and agency reports,[202] as have some states.[203] The Supreme Court has held that a state cannot claim copyright protection for judicial decisions.[204] Significantly, however, there are other cases in which government copyright claims have been recognized or entertained. For example, the Second Circuit has said that official tax maps created by a New York county do not automatically enter the public domain.[205] Outside the United States, government copyrighting is more common: for instance, the "Crown copyright" in the United Kingdom applies to government-created works for fifty years from the time of publication (or 125 years for unpublished works).[206] But even in the Crown copyright context, members of the public generally can license government-created works for free or for a nominal fee.[207] Instances of governments generating creative works and then selling access at an above-marginal-cost price are relatively rare.[208]

202. 17 U.S.C. § 105 (2018).

203. *See, e.g.*, County of Santa Clara v. Superior Court, 89 Cal. Rptr. 3d 374, 395-400 (2009) (rejecting the California county's claim that state law allows it to claim copyright protection with respect to county's geographic information-system basemap).

204. *See* Banks v. Manchester, 128 U.S. 244, 253-54 (1888).

205. *See* County of Suffolk v. First Am. Real Estate Sols., 261 F.3d 179, 195 (2d Cir. 2001). A distinct but related question arises when privately authored standards and codes are incorporated into public law. *See, e.g.*, Shubha Ghosh, *Deprivatizing Copyright*, 54 CASE W. RES. L. REV. 387, 453-61 (2003) (surveying cases). In those instances, IP is used both to incentivize creation and (if copyright is respected after the standard or code is incorporated) to allocate access, notwithstanding the government's use of the material for public purposes.

206. Copyright, Designs and Patents Act 1988, c. X, § 163 (UK); *see* Ruth L. Okediji, *Government as Owner of Intellectual Property? Considerations for Public Welfare in the Era of Big Data*, 18 VAND. J. ENT. & TECH. L. 331, 347-48 (2016).

207. Okediji, *supra* note 206, at 348.

208. *See supra* Section II.B.2 (reviewing these justifications in the patent context).

More common are *mixes* of IP and non-IP tools on the incentive side of the (sometimes permeable) incentive/allocation divide. Despite what is sometimes described as an aversion to aesthetic judgments by government decision makers,[209] the National Endowment for the Arts (NEA) distributes around $110 million per year—a sum that, though it might seem substantial on its own, amounts to well under 0.01% of the federal budget—to writers, artists, and creative initiatives across the country.[210] A writer or artist who receives an NEA grant is in no way precluded from also claiming copyright protection. Thirty-one states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands offer tax incentives for film production.[211] The largest such program, in New York state, offers $420 million in refundable tax credits per year.[212] Upfront rewards help to offset the capital costs of moviemaking and might be rationalized on those grounds,[213] though some see these tax incentives as part of a "race to the bottom" among states seeking to lure business away from their neighbors.[214] These tax incentives, like NEA grants, are supplements to rather than substitutes for traditional IP protection. Even the pages of the *Yale Law Journal* exhibit mixing in action: faculty members at public (and, to a lesser extent, private) universities rely in part on government funding while also claiming copyright protection for their creative works.

For creative works perhaps even more than for other knowledge goods, we can anticipate a potentially compelling argument in favor of content- and viewpoint-neutral subsidies (to borrow terms from First Amendment jurisprudence). We might argue that we do not want the government dictating the substance of creative works, but we do want some subsidy for producers and

209. *See* Brian Soucek, *Aesthetic Judgment in Law*, 69 ALA. L. REV. 381, 382-83 (2017).

210. *2016 Annual Report*, NAT'L ENDOWMENT FOR ARTS 1, 6 (2017), https://www.arts.gov/sites/default/files/2016%20Annual%20Report%20FINAL.pdf [https://perma.cc/D783-V843]; *Quick Facts*, NAT'L ENDOWMENT FOR ARTS 1, https://www.arts.gov/sites/default/files/nea-quick-facts.pdf [https://perma.cc/7955-TLSS]. Per capita public funding for the arts is substantially higher in other developed countries. *See* Research Div., *International Data on Government Spending on the Arts*, NAT'L ENDOWMENT FOR ARTS 1, 9 tbl.1 (Jan. 2000), https://www.arts.gov/sites/default/files/74.pdf [https://perma.cc/6YJ8-36NW].

211. *See State Film Production Incentives & Programs*, NAT'L CONF. ST. LEGISLATURES 1 (Jan. 30, 2018), https://www.ncsl.org/Portals/1/Documents/fiscal/2018StateFilmIncentivePrograms_20189.pdf [https://perma.cc/J9D8-4DH9].

212. *2016 Annual Report*, *supra* note 210, at 13.

213. *See supra* Section II.C.1.b.

214. *See, e.g.*, Ted Johnson, *Former Labor Secretary Robert Reich: Production Tax Incentives Create 'A Race to the Bottom*,' VARIETY (Nov. 19, 2013, 7:39 PM PT), https://variety.com/2013/biz/news/robert-reich-former-labor-secretary-says-movie-and-tv-tax-incentives-create-a-race-to-the-bottom-1200856000 [https://perma.cc/4NLJ-936T].

consumers. Copyright protection does not allow creators to capture all of the positive externalities of their work,[215] and proprietary pricing leads to inefficient restrictions on access. Under these circumstances, a subsidy such as the charitable-contribution deduction, which does not entail the government picking and choosing among works but does promote both production and access, seems close to optimal.[216]

Consideration of creative works also draws our attention to the expressive interests at stake in the production and allocation of knowledge goods. Does J.K. Rowling have a legally cognizable interest in, say, determining whether Harry Potter and Hermione Granger ultimately pair off?[217] A detailed discussion of fan fiction in copyright law lies well beyond our present scope.[218] But the Harry-Hermione example is intended to show that in the context of creative works, authors and artists may have an interest (sometimes characterized as a "moral right") in determining how their works are used ex post. Simply replicating the pecuniary returns from a copyright-conferred monopoly would not leave the creator indifferent between non-IP and IP rewards.[219]

---

215. To be sure, copyright protection now lasts for the life of the creator plus seventy years, which would seem to lead to internalization of almost all the present value of a creative work. *See* 17 U.S.C. § 302(a) (2018). But other elements of copyright law, such as the fair use doctrine, limit the reach of copyright protection. *See id.* § 107; *see also* Campbell v. Acuff-Rose Music, Inc., 510 U.S. 569, 574-78 (1994) (discussing the evolution and elements of fair use). And even before any question of fair use arises, the monopoly conferred by copyright law is limited. For example, *The Sopranos* might have changed television in ways that made *Breaking Bad* possible, but HBO (which made *The Sopranos*) would likely face insurmountable legal obstacles (and perhaps judicially imposed sanctions) if it sued Sony Pictures, the studio behind *Breaking Bad*, for copyright infringement.

216. This is not to say that the government should be viewpoint neutral in all realms: we probably do want the government to be allowed to print Harriet Tubman's face on postage stamps without printing Adolf Hitler's. We discuss the origins and justifications for the First Amendment government speech doctrine at greater length in Daniel J. Hemel & Lisa Larrimore Ouellette, *Public Perceptions of Government Speech*, 2017 SUP. CT. REV. 33.

217. *See* Antonia Molloy, *Harry Potter Should Have Married Hermione, Admits J K Rowling*, INDEPENDENT (Feb. 2, 2014), https://www.independent.co.uk/arts-entertainment/harry-should-have-married-hermione-says-j-k-rowling-9102110.html [https://perma.cc/G4K7-WE4C].

218. For more extended discussions, see, for example, Anupam Chander & Madhavi Sunder, *Everyone's a Superhero: A Cultural Theory of "Mary Sue" Fan Fiction as Fair Use*, 95 CALIF. L. REV. 597 (2007); and Rebecca Tushnet, *Legal Fictions: Copyright, Fan Fiction, and a New Common Law*, 17 LOY. L.A. ENT. L. REV. 651 (1997).

219. This does not mean that recognizing a creator's expressive interests is necessarily salutary. If legal recognition of such interests—such as through a right of attribution—creates a wider gap between creators' and users' valuation of a work, it may decrease efficient transactions over creative goods. *See* Christopher Jon Sprigman et al., *What's a Name Worth?: Experimental Tests of the Value of Attribution in Intellectual Property*, 93 B.U. L. REV. 1389, 1428-31 (2013).

Yet as Jeanne Fromer has argued, expressive interests in intellectual property are not confined to the copyright context.[220] Inventors whose work would historically be eligible for patent protection also have potentially powerful personhood interests bound up in their inventions. In some cases, inventors might care deeply that their work be available to the public on an open-access basis.[221] In other instances, they might care about *controlling* access and thus maintaining the ability to mediate between "acceptable" and "unacceptable" uses.[222] As Fromer has suggested, the prospect of being able to control access ex post may be one element of the motivation for creators to create and for inventors to invent.[223] For a non-IP reward to match IP's innovation incentive, then, the pecuniary reward may need to be scaled up to compensate the producer not only for the loss of monopoly profits but also for the loss of control over access (and there are perhaps some creators or inventors who will swear that *no* amount of money would compensate them for the loss of control).

Lastly with respect to copyrights, our discussion of layering has direct application to the sharing of creative works across borders. Consider, for example, the international licensing of British Broadcasting Corporation (BBC) shows such as *Doctor Who*.[224] Focusing solely on the United Kingdom, we might describe production and allocation as governed by non-IP regimes: a government corporation produces the show, which is then distributed for free domestically (though U.K. residents under age seventy-five who have televisions in their homes are obligated to pay a license fee that covers some of the BBC's costs[225]). The BBC then uses international IP law to spread costs across the dozens of countries where *Doctor Who* is watched.[226]

The application of our framework to a third area of IP, trademark law, is less obvious, and our observations are more tentative. Judges as well as casebook and treatise authors have emphasized that trademark law is *not* intended to be an

---

220. *See* Jeanne C. Fromer, *Expressive Incentives in Intellectual Property*, 98 VA. L. REV. 1745, 1771-81 (2012).

221. *See, e.g.*, Yochai Benkler, *Coase's Penguin, or Linux and* The Nature of the Firm, 112 YALE L.J. 369, 373-74 & nn.10-12 (2002) (discussing motivations of open-source software developers).

222. Katherine J. Strandburg, *Users as Innovators: Implications for Patent Doctrine*, 79 U. COLO. L. REV. 467, 499 (2008).

223. *See* Fromer, *supra* note 220, at 1761-64.

224. *See Doctor Who* (British Broadcasting Corp. 1963-1989, 1996, 2005-present).

225. *See TV Licensing Types and Costs*, TV LICENSING (2018), https://www.tvlicensing.co.uk/check-if-you-need-one/topics/tv-licence-types-and-costs-top2 [https://perma.cc/5QDR-YG8M].

226. *Over 75 Countries to Simultaneously Broadcast* Doctor Who *50th Anniversary Special*, BBC (Mar. 18, 2014, 6:07 PM), https://www.bbc.co.uk/mediacentre/worldwide/011013doctorwho.html [https://perma.cc/M6VK-469W].

innovation incentive,[227] and so the innovation-incentive/allocation-mechanism framework might seem like an awkward fit. Yet trademark law can be characterized as promoting product differentiation, which might be seen to generate positive externalities. For example, Coca-Cola's investments in developing a distinct mark and trade dress arguably benefit not only Coca-Cola and the consumers who purchase it but also the shoppers who are looking for Pepsi.

Trademark law is not, however, the only way in which society supports investments in product differentiation. The federal income tax treatment of advertising costs—allowing a full deduction in the year that the expense is incurred—historically has operated as a subsidy for advertising expenditures, as it relieves advertising costs from the normal rule of capitalization and amortization for investments that generate benefits beyond the taxable year.[228] The notion of using nontrademark tools to promote investment in product differentiation arguably becomes more attractive as the problems with trademark grow more acute. For example, Barton Beebe and Jeanne Fromer conclude on the basis of a systematic study of roughly seven million trademarks and trademark applications that the supply of standard English words, common American surnames, and short neologisms available for trademark registration is approaching exhaustion.[229] If indeed trademark provides an ever-less-useful way to distinguish among brands,

---

227. *See* TrafFix Devices, Inc. v. Mktg. Displays, Inc., 532 U.S. 23, 34 (2001) ("The Lanham Act does not exist to reward manufacturers for their innovation in creating a particular device; that is the purpose of the patent law and its period of exclusivity."); Qualitex Co. v. Jacobson Prods. Co., 514 U.S. 159, 164 (1995) ("It is the province of patent law, not trademark law, to encourage invention by granting inventors a monopoly over new product designs or functions for a limited time."); 1 J. THOMAS MCCARTHY, MCCARTHY ON TRADEMARKS AND UNFAIR COMPETITION § 6:3 (4th ed. 2017) ("Unlike patent law, the purpose of trademark and trade dress law is to prevent customer confusion and protect the value of identifying symbols, not to encourage invention."); MENELL ET AL., *supra* note 7, at 26 ("Unlike patent and copyright, trademark law does not protect innovation or creativity directly. Rather, it aims to protect the integrity of the marketplace . . . ."). For a contrary view, see George & Ouellette, *supra* note 163.

228. *See* DALE L. FLESHER, ACCOUNTING FOR ADVERTISING ASSETS 2 (1979) ("The fact that the U.S. Internal Revenue Service has permitted advertising costs to be deducted in the year of incurrence has resulted in advertising becoming a tax shelter."); Mona L. Hymel, *Consumerism, Advertising, and the Role of Tax Policy*, 20 VA. TAX REV. 347, 414-43 (2000) (describing the tax treatment of advertising and the way in which the immediate-deduction rule for advertising expenditures deviates from generally applicable capitalization principles). Note that from September 2017 until the end of 2022, taxpayers can claim an immediate deduction for almost all capital expenditures other than real property, *see* I.R.C. § 168(k)(6) (2018), so for this brief period, the preferential treatment historically afforded to advertising will be available more widely.

229. *See* Barton Beebe & Jeanne C. Fromer, *Are We Running Out of Trademarks? An Empirical Study of Trademark Depletion and Congestion*, 131 HARV. L. REV. 945, 951-53 (2018).

then we might consider whether non-IP tools, including tax incentives, can promote investment in the public good of product differentiation.[230] Arguably they already do.

B. Matching, Mixing, and Layering Beyond IP

While our thoughts on trademark law are tentative, our reflections on our framework's implications for—and interactions with—the law of real property are even more so, in part because the study of terra firma is terra incognita for us both. Nevertheless, we believe that our approach can parallel with—and might even offer insights for—the study of real property and land use. More generally, we see our project as consistent with, and perhaps contributing towards, an emerging project among scholars of intellectual and real property alike that aims to disaggregate and destabilize the very idea of "property."

We start with the most obvious overlaps. The notion that the government might purchase real-property rights from holders and then make that property available to all—what we might call a *property-nonproperty match*—is familiar from the land-use context. (Indeed, the power of eminent domain allows the government to consummate these transactions even over the holder's refusal.) Likewise, the idea that the government might "produce" real property itself and then sell or give away the right to exclude—a *nonproperty-property match*—is reflected in the shape of many American cities that sit (sometimes uneasily) on landfill.[231] *Mixes* of property and nonproperty incentives, as well as property and nonproperty allocation mechanisms, are widespread too. On the supply side, the government incentivizes the production and rehabilitation of affordable housing by combining property-rights protection with the Low Income Housing Tax Credit.[232] On the demand side, subsidies such as the Section 8 Housing Choice Vouchers Program make access to housing available to low-income families for an amount greater than zero but less than the rent they would pay in a pure

---

230. On the normative implications of Beebe and Fromer's empirical findings, see Lisa Larrimore Ouellette, *Does Running Out of (Some) Trademarks Matter?*, 131 HARV. L. REV. F. 116 (2018).

231. *See, e.g.*, NANCY S. SEASHOLES, GAINING GROUND: A HISTORY OF LANDMAKING IN BOSTON 1-11 (2003). Another example is the U.S. government's use of federal funds to purchase land west of the Mississippi River followed by its disposition of this government land through free property rights under the Homestead Acts. For a brief overview of this history, a model comparing nineteenth-century land distribution to awarding property rights in innovations, and an example of fruitful dialog between real- and intellectual-property law, see Terry L. Anderson & Peter J. Hill, *The Race for Property Rights*, 33 J.L. & ECON. 177, 178, 184-85 (1990).

232. *See* I.R.C. § 42 (2018).

proprietary-pricing system.[233] And while the international trade in knowledge goods finds no real-property parallel, one might draw an analogy between IP layering and the Westphalian system of territorial sovereignty: each country enjoys something akin to a fee-simple absolute interest in its own territory but remains free to choose among property and nonproperty regimes to allocate land domestically.

For the conversation between real property and intellectual property scholars to generate useful insights, however, it must go beyond simply identifying the many ways in which the regimes for tangible and intangible assets mirror one another. It must identify ways in which real-property regimes, actual or imagined, might inform the design of innovation policy, and vice versa. Consider one example. A number of authors—including Lee Fennell, Saul Levmore, Florenz Plassmann, Nicolaus Tideman, and, most recently, Eric Posner and Glen Weyl[234]—have discussed the possibility of self-assessment regimes for real property as a solution to anticommons problems in the land-use context. The basic idea is that property owners would self-assess the value of their property and would report that value to a central registry. Owners would pay an annual tax calculated as a percentage of the self-assessed value, generating an incentive not to overstate. Meanwhile, any interested buyer would have the right to force the owner to sell the property for the self-assessed value, generating an incentive not to understate. (A variant of such a regime was in fact implemented in Taiwan from the 1950s to the 1970s, though it allowed only the government—and not any third-party purchaser—to acquire real property for the self-assessed price.[235]) A key advantage of this sort of regime (aside from revenue raising) is

233. *See Housing Choice Vouchers Fact Sheet*, U.S. DEP'T HOUSING & URB. DEV., https://www.hud.gov/program_offices/public_indian_housing/programs/hcv/about/fact_sheet [https://perma.cc/4X8D-2UD5]. Arguably, the substantially more expensive home-mortgage interest deduction should headline the list of housing subsidies. However, the view among many economists is that much of the subsidy from the mortgage interest deduction (MID) is capitalized into housing prices and so does little to expand access to homeownership in the aggregate. *See, e.g.*, Christian A.L. Hilber & Tracy M. Turner, *The Mortgage Interest Deduction and Its Impact on Homeownership Decisions*, 96 REV. ECON. & STAT. 618, 635 (2014) (finding that the MID does not impact homeownership attainment in the aggregate, although it does impact individual homeownership decisions depending on the restrictiveness of land-use regulations at the place of residence and the income status of the household).

234. *See* Lee Anne Fennell, *Revealing Options*, 118 HARV. L. REV. 1399, 1442-43 (2005); Saul Levmore, *Self-Assessed Valuation Systems for Tort and Other Law*, 68 VA. L. REV. 771, 778-83 (1982); Florenz Plassmann & T. Nicolaus Tideman, *Accurate Valuation in the Absence of Markets*, 36 PUB. FIN. REV. 334, 335-37 (2008); Eric A. Posner & E. Glen Weyl, *Property Is Only Another Name for Monopoly*, 9 J. LEGAL ANALYSIS 51, 60-70 (2017).

235. *See* Yun-chien Chang, *Self-Assessment of Takings Compensation: An Empirical Study*, 28 J.L. ECON. & ORG. 265, 268-70 (2012).

that it would make it easier to assemble parcels held by different owners for a more productive use without holdouts derailing the plan. A disadvantage is that the tax—which is necessary to elicit accurate self-assessments—also deters property holders from making value-enhancing investments in the property because some of the increase in value is lost to the tax.[236]

Mixing might help to solve this problem. If imposing an ex post tax on the increase in value of the property right reduces incentives to invest, then adding an ex ante nonproperty subsidy for investment (e.g., a tax credit for spending on structures) might serve to offset. To be sure, if the goal of the self-assessment regime is to facilitate revenue collection, then the addition of the ex ante tax break is self-defeating. But if the purpose of the ex post tax is simply to encourage honest self-assessment and thus to facilitate land assembly, then combining the ex post tax with an ex ante subsidy for investment would seem to be advantageous. Our analysis above underscores the fact that property is not the only possible mechanism for incentivizing investment. A mix of property and nonproperty incentives for investment, combined with limits on property rights to avoid holdout,[237] might be an improvement over some of the self-assessment regimes already contemplated and implemented.[238]

Posner and Weyl, as well as Michael Abramowicz and John Duffy, have suggested that self-assessment regimes might be useful in the knowledge-good context too.[239] Although a full exploration of that possibility lies beyond the scope of this Article, for present purposes we emphasize a point that is both more modest and more sweeping. The discussion of self-assessment regimes in the real-property context highlights the fact that market-based mechanisms can be used in ways that destabilize traditional notions of property rights—the free market is not coterminous with the fee-simple absolute. Likewise, our analysis of matching and mixing reveals ways in which policy makers can harness market mechanisms to incentivize innovation and allocate access to knowledge goods without adopting a pure IP regime. From patent buyouts[240] to Bayh-Dole market tests[241] to reliance on venture capital to finance entrants in government-sponsored prize

236. *See* Posner & Weyl, *supra* note 234, at 63-64.

237. That is, the property ownership in the land plus the tax on the self-assessed value provides a property incentive for investment with a limitation to avoid holdout, and the ex ante subsidy for investment is a nonproperty incentive to compensate for that limitation.

238. Ancient Athens, New Amsterdam (the predecessor to New York), New Zealand, and Colombia also have implemented self-assessment regimes at different times. *See* Chang, *supra* note 235, at 267 n.14.

239. *See* Michael Abramowicz & John F. Duffy, *Ending the Patent Monopoly*, 157 U. PA. L. REV. 1541, 1598-1600 (2009); Posner & Weyl, *supra* note 234, at 114.

240. *See supra* notes 57-64 and accompanying text.

241. *See supra* notes 77-81 and accompanying text.

competitions, innovation policy pluralism need not entail the replacement of market mechanisms with central planning. While policy makers might have persuasive reasons to reject market-based estimates of social value in the knowledge-good context, our analysis—informed by real-property scholarship on market-based alternatives to fee-simple regimes—reminds us that IP and markets need not travel together in the innovation domain.

CONCLUSION

Intellectual property is not a monolith. Throughout this Article, we have demonstrated that the bundle known as "intellectual property" can be disaggregated into an ex post, market-set *innovation incentive* and an *allocation mechanism* based on proprietary pricing. We have shown that non-IP alternatives are possible on both sides of the incentive/allocation divide. We have analyzed a number of ways that IP and non-IP innovation incentives and allocation mechanisms might be combined in theory and in practice.

Table 1 below recapitulates our framework. Matching an IP innovation incentive with a non-IP allocation mechanism may be desirable when policy makers seek to harness the motivational power of ex post rewards or to leverage private information on consumers' willingness to pay for a new knowledge good, all while avoiding the deadweight loss of proprietary pricing. Matching a non-IP innovation incentive with an IP allocation mechanism may be attractive when policy makers seek to spur initial discovery with a government-set, risk-free reward that does not compel researchers to turn to capital markets, while at the same time using market power to encourage the commercialization of new knowledge goods or the management of negative externalities. Mixing IP and non-IP innovation incentives may be desirable when neither market-generated nor politically produced estimates of social value are accurate, and when accuracy can be enhanced by combining the two. Mixing on the allocation side of the divide may occur for informational reasons (to encourage consumers to reveal some data about willingness to pay) or for distributional reasons (to impose a partial user-pays system). All this can occur beneath a layer of international law that binds countries to a cross-border IP regime.

The normative implications of innovation policy pluralism are, we think, significant and multifaceted. As we have argued throughout this Article, pluralistic innovation policy arrangements can advance social goals under a wide range of circumstances. Yet the implications that follow from our analysis go beyond discrete policy prescriptions. We believe that the pluralistic approach outlined in this Article should shape the way that scholars and policy makers think and talk about IP and its alternatives. Critiques of IP that focus on the "crowding out" effect of IP's market-based innovation incentive do not necessarily implicate the use of proprietary pricing to allocate access. Concerns about the deadweight loss of IP monopolies do not necessarily preclude the use of market-based signals to set rewards for the production of knowledge goods. Defenses of IP that emphasize the superiority of market signals over government direction do not justify the use of IP for allocative purposes, and arguments in favor of IP based on user-pays principles do not necessary explain reliance on IP for incentive purposes. Finally, innovation policy choices at the international and national levels can be delinked, with countries converging on one approach at the global level while going their own ways domestically. These insights suggest that participants in debates about innovation policy should demand and supply arguments aimed specifically at the aspect of IP that they believe merits preservation or warrants change. While pure IP and purely non-IP policies may be appropriate under certain circumstances, they are only so when both the innovation incentive and the access allocation components have been scrutinized and justified.

Fortunately, the all-or-nothing assumptions that sometimes seep into debates about innovation policy have not prevented pluralistic arrangements from emerging in the real world. Matching, mixing, and layering already are prevalent in practice, with the pharmaceutical sector providing a particularly clear illustration of all three strategies being deployed. Oftentimes this pluralism occurs by accident, but we hope that a nuanced understanding of IP's distinct components will facilitate the strategic use of pluralistic approaches as policy makers confront new innovation challenges. Our hope is that the analysis offered in this Article can aid the evaluation of existing pluralistic arrangements and open the door to new combinatorial possibilities. Innovation policy pluralism can frame conversations, encourage experimentation, and enrich the menu of options available for producing and disseminating knowledge goods.

TABLE 1.
MIXING, MATCHING, AND LAYERING OF IP AND NON-IP POLICIES

	Strategy	Rationale(s)	Examples
Matching	IP innovation incentive with non-IP allocation mechanism	– Harness motivational power of ex post reward – Leverage private information on willingness to pay for innovation – Avoid deadweight loss of proprietary pricing	– Government patent buyouts at market-determined prices, with invention then placed into public domain
	Non-IP innovation incentive with IP allocation mechanism	– Alleviate capital constraints through upfront financing – Rely on democratic decision-making process to select projects worthy of support – Allow for market power to encourage commercialization after initial innovation – Use proprietary pricing to regulate negative externalities	– Exclusive licensing of government-funded innovations to private-sector firms – (Proposed) extended patent life for resistance-prone antibiotics
Mixing	IP and non-IP innovation incentives	– Combine information on social value from economic and political markets	– Allow government-funded researchers to seek patents
	IP and non-IP allocation mechanisms	– Glean information from consumers' willingness to pay without full deadweight loss of proprietary pricing – Shift portion of product costs to users for distributional reasons	– Partial government subsidies for purchases of patented products
Layering	International IP with non-IP or hybrid domestic regimes	– Share costs of knowledge production across countries without forcing any country to pay more than the value it derives from innovation	– Overseas patenting activity by U.S. universities that conduct government-funded research (often with foreign governments then reallocating to citizens through non-IP mechanisms)