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Article

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INTRODUCTION

Ever since Adam Smith, economists have recognized that nation-states play an important role in subsidizing the production of knowledge goods.[1] The simple case for state subsidization goes as follows: Self-interested individuals and firms will devote their time and money toward producing knowledge goods only up to the point that the marginal benefit they reap from the investment exceeds the marginal cost. Yet persons other than the producer also benefit from new knowledge goods, and unless the producer takes the interests of these others into account, she will invest less than the socially optimal amount. This is where nation-states enter the picture. States can encourage the provision of knowledge goods by enhancing the private rewards to producers or by reducing producers' costs. By doing either (or both), nation-states can bring investment in knowledge-good provision closer to the socially optimal level.

Smith suggested that "the easiest and most natural way in which the state can recompense" producers of knowledge goods is by granting them a "temporary monopoly"—that is, a patent or copyright.[2] Intellectual property (IP) rights enhance producers' rewards by allowing them to charge higher prices. In this respect, IP is akin to a tax on knowledge goods, with the revenues going to knowledge-good producers.[3] But IP has a poten-

1. By "knowledge good," we mean (appropriating economist Hal Varian's definition) "anything that can be digitized." HAL VARIAN, MARKETS FOR INFORMATION GOODS 3 (1999). Books, blueprints, films, and pharmaceutical formulas are all examples of knowledge goods. We use the term "nation-state" to distinguish national-level actors (our "nation-states") from subnational actors (such as U.S. states and Canadian provinces) as well as supranational actors (such as the United Nations and the European Union). *See, e.g.*, ERNST B. HAAS, BEYOND THE NATION-STATE: FUNCTIONALISM AND INTERNATIONAL ORGANIZATION 26 (1964).

2. 3 ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS 143–44 (4th ed. London, W. Strahan & T. Cadell 1786) (bk. V, ch. 1, para. 119).

3. *See* Nancy Gallini & Suzanne Scotchmer, *Intellectual Property: When Is It the Best Incentive System?*, *in* 2 INNOVATION POL'Y & ECON. 51, 54 (2002); Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents–Prizes Debate*, 92 TEX. L. REV. 303, 312–14, 371–73 (2013).

tially undesirable feature: it functions as a concentrated tax on a subset of goods. A concentrated tax is generally less efficient than a uniform tax on all goods (or equivalently, a tax on labor income).[4] Accordingly, scholars of law and economics often describe IP as a "second-best" mechanism for encouraging the provision of knowledge goods—inferior to incentives financed through broad-based taxation.[5]

Notwithstanding this undesirable feature of IP, most nation-states do use patents and copyrights to recompense producers of knowledge goods.[6] But many nation-states simultaneously subsidize the production of knowledge goods through other mechanisms, such as prizes, grants, and tax credits.[7] Nation-states also support technological innovation by conducting research in-house, through agencies such as the U.S. National Institutes of Health and the U.K. National Physical Laboratory.[8] States generally fund these non-IP mechanisms through broad-based taxes rather than concentrated taxes on certain goods.[9] For this reason, non-IP incentives in many circum-

4. *See* Hemel & Ouellette, *supra* note 3, at 314–15 (citing Steven Shavell & Tanguy Van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525, 526–627 (2001)). For a clear explanation of the equivalence between a labor income tax and a uniform tax on all goods, see Joseph Bankman & David A. Weisbach, *The Superiority of an Ideal Consumption Tax over an Ideal Income Tax*, 58 STAN. L. REV. 1413, 1417–18 (2006).

5. *See, e.g.*, Gene Grossman & Edwin L.-C. Lai, *International Protection of Intellectual Property*, 94 AM. ECON. REV. 1635, 1640 (2004); *see also* Amy Kapczynski, *Intellectual Property's Leviathan*, LAW & CONTEMP. PROBS., Fall 2014, at 131, 133 ("[M]any leading economists—including, most famously, Nobel Prize winner Kenneth Arrow—have suggested that the most efficient means to promote information production involves not exclusion rights but public procurement."). For a discussion of the compensating benefits of "user pays" incentives like IP, see Hemel & Ouellette, *supra* note 3, at 350–51.

6. Following the international IP literature, we consider copyright alongside patents. But as discussed below, we are skeptical of how well the conventional economic account of IP treaties fits for creative works. Trade secrets, while not the focus here, serve similar functions to patents. *See* Mark A. Lemley, *The Surprising Virtues of Treating Trade Secrets as IP Rights*, 61 STAN. L. REV. 311 (2008). Trademarks have some limited similarities to public goods, *see* David W. Barnes, *A New Economics of Trademarks*, 5 NW. J. TECH. & INTELL. PROP. 22, 24 (2006), but are best justified on other grounds, *see, e.g.*, Mark A. Lemley & Mark P. McKenna, *Owning Mark(et)s*, 109 MICH. L. REV. 137, 172 (2010).

7. *See* Hemel & Ouellette, *supra* note 3, at 315–26.

8. *See* Rochelle Cooper Dreyfuss, Response, *Tailoring Incentives: A Comment on Hemel and Ouellette's Beyond the Patents–Prizes Debate*, 92 TEX. L. REV. SEE ALSO 131, 132 (2014).

9. Non-IP incentives *could* be financed through a sales tax on knowledge goods, which would lead to the same inefficiency as the IP "tax." *See* Hemel &

stances may be more efficient than patents and copyrights: they may yield the same output of knowledge goods while generating less deadweight loss (and also posing fewer deterrents to cumulative innovation).[10]

Yet the same characteristics of knowledge goods that give rise to the argument for state subsidization also engender a challenge for nation-states that seek to subsidize knowledge production in an interconnected world. First, knowledge goods are generally nonrivalrous: the fact that a person in another country watches the same movie as you or uses the same drug does not decrease your enjoyment of the good—and may even increase it. (Antibiotics are an exception.)[11] Second, knowledge goods are only partially excludable: in the absence of IP law, the producer of a knowledge good cannot always prevent others from using the good without payment. (Think unauthorized movie downloads and generic drugs.)[12] Where the first characteristic (nonrivalrousness) is present, the global benefit from the production of a new knowledge good is greater than the benefit to the citizens of any one nation-state. And where the second characteristic (nonexcludability) is present, citizens of other countries can free-ride off the efforts of the nation-state that pays the subsidy. Rational, self-interested nation-states will finance knowledge goods only up to the point that the marginal cost equals the marginal benefit to their own citizens. This means that absent international coordination, nation-states will subsidize knowledge goods at less than the globally optimal level.[13]

Notably, this prediction applies to IP and non-IP innovation incentives alike. Absent coordination, rational self-

Ouellette, *supra* note 3, at 347; Benjamin N. Roin, *Intellectual Property Versus Prizes: Reframing the Debate*, 81 U. CHI. L. REV. 999, 1058–59 (2014).

10. By "deadweight loss," we mean the economic inefficiency that results from foregone transactions when the price of a product exceeds its marginal cost. *See* SUZANNE SCOTCHMER, INNOVATION & INCENTIVES 36 (2004); *see also* Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031, 1059–64 (2005) (reviewing the costs of IP protection).

11. *See infra* note 41.

12. This is not to say that generics are costless to produce; rather, reverse engineering a drug and relying on clinical trial data showing it is effective is simply far cheaper than producing this knowledge in the first place. *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 (2010).

13. Of course, not all knowledge goods have these characteristics requiring state intervention. *See infra* notes 41–42 and accompanying text.

interested nation-states will protect IP only insofar as the marginal benefit to their citizens from additional IP protection (in the form of increased innovation) exceeds the marginal cost (including deadweight loss). Such states will apply a similar calculus when deciding how much to subsidize the production of knowledge goods through broad-based taxation. This is not to suggest that rational and self-interested nation-states will offer *no* innovation inducements; rather, this logic suggests that state investment in innovation will be globally suboptimal (though likely not zero).

But there is one important difference between IP and non-IP incentives that alters this prediction. Most nation-states (164 in all) have signed and ratified the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which requires all except the least-developed countries to protect IP at or above a minimum level.[14] That is, nation-states have responded to the collective-action problem by virtually all agreeing to support the production of knowledge goods through IP protection. There is no equivalent with respect to non-IP mechanisms—no large-scale international agreement obligating nation-states to pay for prizes, grants, tax credits, or in-house government research. The only comprehensive solution to the problem of knowledge-goods provision that nation-states have struck is an IP solution.

The fact that nation-states have chosen to use international IP treaties—rather than non-IP mechanisms—to coordinate their subsidies for knowledge-good production presents something of a puzzle: If IP protection yields greater deadweight loss than non-IP innovation incentives, why have states settled upon IP as a solution to their collective-action problem?[15] Why not,

14. Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299, 33 I.L.M. 1197 [hereinafter TRIPS]; *see also Members and Observers*, WORLD TRADE ORG., https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm (last updated July 29, 2016); *Responding to Least Developed Countries' Special Needs in Intellectual Property*, WORLD TRADE ORG., https://www.wto.org/english/tratop_e/trips_e/ldc_e.htm (last updated Oct. 16, 2013).

15. Note that we are not asking "why" in the sense of seeking the stated motivations of the primary actors involved in treaty negotiations. We are asking why these multinationals focused on IP rather than an alternative rent-extraction tool, and why other nation-states were willing to sign on. For a leading examination of the role of U.S. multinationals in bringing TRIPS into being, see SUSAN K. SELL, PRIVATE POWER, PUBLIC LAW: THE GLOBALIZATION OF INTELLECTUAL PROPERTY RIGHTS (2003).

say, a global treaty requiring signatory states to allocate a percentage of gross domestic product to research and development?[16] Or why not, as Joseph Stiglitz has proposed, a global prize fund financed by national governments that rewards innovators in targeted fields (e.g., medical knowledge)?[17]

A possible answer is that a treaty focused on non-IP mechanisms is too difficult to negotiate or implement.[18] We find this answer unsatisfactory. True, there is no multilateral institution capable of imposing a broad-based tax on an international basis. But by the same token, there are no international courts capable of enforcing IP law against private actors in different countries, and yet nation-states nonetheless have been able to set up a global IP system. The transaction costs of negotiating a global R&D treaty would be significant—and the subsequent monitoring and enforcement costs even more so—but the same can be said of any comprehensive international IP accord. And even if non-IP mechanisms would entail higher administrative costs, that still leaves the question of whether that administrative cost difference would exceed the greater deadweight loss of proprietary pricing in an IP regime.

The previous paragraph assumes that deadweight loss in an IP system exceeds deadweight loss under a non-IP alternative. That assumption is the basis for the conventional critique of IP. While the assumption may be credible in the domestic IP context,[19] the same assumption cannot be extended to the in-

16. *See, e.g.*, Tim Hubbard & James Love, *A New Trade Framework for Global Healthcare R&D*, 2 PLOS BIO. 147 (2004) (describing a proposed framework wherein countries directly contribute to healthcare R&D).

17. *See* Joseph E. Stiglitz, *Scrooge and Intellectual Property Rights*, 333 BRIT. MED. J. 1279 (2006).

18. *See, e.g.*, Thomas Alured Faunce & Hitoshi Nasu, *Three Proposals for Rewarding Novel Health Technologies Benefiting People Living in Poverty. A Comparative Analysis of Prize Funds, Health Impact Funds and a Cost-Effectiveness/Competitive Tender Treaty*, 1 PUB. HEALTH ETHICS 146, 149 (2008) (discussing the challenges of implementing a global R&D treaty or prize fund); Rachel Kiddell-Monroe et al., *Medical R&D Convention Derailed: Implications for the Global Health System*, J. HEALTH DIPL., Aug. 2013, at 2, http://www.ghd-net.org/abstracts/volume-1/2 (noting a breakdown in R&D treaty negotiations).

19. Even in the domestic context, nation-states can use IP as an innovation incentive while allocating access to knowledge goods through mechanisms that generally avoid the deadweight loss associated with proprietary pricing. *See, e.g.*, Michael Kremer, *Patent Buyouts: A Mechanism for Encouraging Innovation*, 113 Q.J. ECON. 1137 (1998) (discussing patent buyouts as a means of reducing deadweight loss). In a project in progress, we further explore the possibility of pairing IP-based innovation incentives with access allocation mech-

ternational setting. Proprietary pricing for knowledge goods results in substantial deadweight losses, but even the strongest international IP regime does not necessarily result in proprietary pricing for knowledge goods at the domestic level. To be sure, the global IP regime establishes a structure for setting the size of the rewards that innovators can claim, and it requires states to establish an IP system. But significantly, this structure does not dictate the way that states must incentivize knowledge production and allocate access to knowledge goods within their own borders; in this sense, IP is merely a default.

On the supply side of the knowledge-goods equation, international IP law does not force states to adopt any one approach for incentivizing innovation. States still can use non-IP mechanisms—prizes, grants, tax credits, and the like—to encourage the production of knowledge. International IP law enables nation-states that subsidize the production of knowledge goods to seek compensation from consumers elsewhere who benefit from those goods, but—at least as a formal matter—international IP law still leaves states wide leeway with respect to internal incentive structures. For example, a nation-state can require prize claimants to relinquish their IP rights as a condition for receiving the prize—and the national government can then keep for itself future revenues from licensing the knowledge good abroad. Less directly but more commonly, nation-states can subsidize the domestic production of knowledge goods through non-IP mechanisms such as grants and credits and then collect a share of overseas profits through taxation of the domestic producer. Global IP law creates a framework for figuring out how much State B must pay for knowledge goods generated in State A; it does not dictate the way that State A produces knowledge goods internally.

On the allocation side, states can (and often do) choose non-price mechanisms—funded through broad-based taxation—to distribute knowledge goods at the domestic level. For instance, a nation-state that desires to distribute a patented pharmaceutical to its own citizens at marginal cost can purchase a license from the patentee and pay for the license through broad-based taxation. Nation-states with single-payer health care systems generally follow a variant of this approach, respecting the pharmaceutical maker's IP rights while avoiding

anisms that do not rely on proprietary pricing. *See generally* Daniel J. Hemel & Lisa Larrimore Ouellette, Innovation Policy Pluralism (Aug. 7, 2016) (unpublished manuscript) (on file with authors).

domestic deadweight loss from monopoly pricing.[20] And even in countries such as the United States without single-payer health care, purchases of patented pharmaceutical products are heavily subsidized by the government (e.g., through Medicare Part D, Medicaid, and various health care-related tax expenditures). To the extent that states do allow for access allocation through the mechanism of price, that is only because states have not opted for non-price alternatives.

The common thread connecting the production and allocation stories—and a point that IP scholars have overlooked until now—is that international IP law and domestic policy are separable: nation-states that sign international IP treaties such as TRIPS are not locked into IP-based mechanisms for incentivizing innovation or allocating access to knowledge goods. Nation-states can choose to encourage innovation through non-IP mechanisms, and they can decide to distribute knowledge goods to their citizens at no cost or a discounted price. Even though key features of IP law have been determined internationally, nation-states remain central players in the provision of knowledge goods.

To be clear, we are not arguing that policymakers consciously conceive of international IP in these terms. As scholars such as Susan Sell have documented, the industrialized-country policymakers behind TRIPS were largely driven by private corporate interests, and developing countries agreed to these minimum IP standards based on promises of favorable trade terms.[21] But even if our account does not reflect the motivations of policymakers, we believe that our account does de-

20. *See infra* notes 184–85 and accompanying text. Note, however, that states will only have full autonomy to purchase IP rights and use alternative allocation mechanisms if they can be confident that their investments will not be dispersed to consumers in other countries through international resale markets. TRIPS does not currently dictate whether foreign sales exhaust domestic IP rights. TRIPS, *supra* note 14, art. 6. The Federal Circuit recently decided en banc to uphold the U.S. rule that foreign sales do not exhaust U.S. patent rights. *See* Lexmark Int'l, Inc. v. Impression Prods., Inc., 816 F.3d 721 (Fed. Cir. 2016) (en banc). As we explain in a separate essay, reversal of the current rule would undermine a key benefit of the current international system. Daniel J. Hemel & Lisa Larrimore Ouellette, *Trade and Tradeoffs: The Case of International Patent Exhaustion*, 116 COLUM. L. REV. SIDEBAR 17, 21–22 (2016).

21. *See* SELL, *supra* note 15, at 96 ("In effect, twelve corporations made public law for the world."); *id.* at 110 ("[D]eveloping countries received promises of greatly expanded market access for their agricultural products and textiles in exchange for agreeing to offer greater IP protection.").

scribe the function that international IP actually serves. International IP sets a framework for transfers from knowledge consumers to knowledge producers—and within this framework, international IP allows nation-states to choose non-IP mechanisms on the incentive side and the allocation side, and to recoup some of the cross-border benefits of their non-IP investments.[22] States that rely on IP at the domestic level are not forced to do so by international law. While states must establish an infrastructure of IP laws to comply with TRIPS, they are free to employ non-IP alternatives in addition to or instead of IP, whether or not they realize that they have this choice.

We explain and extend this insight further, while considering a range of counterarguments and qualifications. The Article proceeds in four Parts. Part I presents a conventional economic narrative of international IP treaties as the solution to a global public goods problem (drawing heavily from the work of the late innovation economist Suzanne Scotchmer).[23] In short, this account proceeds as follows: Knowledge is a global public good, so in the absence of global coordination such as IP treaties, nation-states will rationally underinvest in its production (the "underinvestment hypothesis"). Coordination through IP treaties at the international level leads to harmonization of innovation policy at the domestic level, and thus excessive reliance on IP relative to non-IP incentives (the "harmonization hypothesis"). And yet IP treaties are the only plausible means of international coordination due to the absence of a global public finance system to fund non-IP incentives such as R&D tax credits (the "uniqueness hypothesis"). We develop a formal economic model to illustrate this account.

Part II draws on international-political-economy scholarship to show why the underinvestment hypothesis is an incomplete explanation of state behavior. The strength of the hypothesis depends on the robustness of its two premises: that knowledge is a global public good and that states seek to maximize absolute gains. Neither of those premises is universal. Knowledge is often not a pure public good, and the extent to which it is a *global* public good depends on the dispersion of

22. *Cf.* Milton Friedman, *The Methodology of Positive Economics, in* THE PHILOSOPHY OF ECONOMICS: AN ANTHOLOGY 145, 158 (Daniel M. Hausman ed., 3d ed. 2008) ("[U]nder a wide range of circumstances individual firms behave *as if* they were seeking rationally to maximize their expected returns.").

23. *See, e.g.*, Suzanne Scotchmer, *The Political Economy of Intellectual Property Treaties*, 20 J.L. ECON. & ORG. 415 (2004).

demand for the knowledge good and the strength of positive local production externalities. Moreover, international-political-economy scholars have presented a number of alternatives to the absolute-gains model that seem to explain at least some state investments in knowledge goods. These alternatives include a "realist" model focused on relative gains and national security, a "constructivist" model focused on the spread of behavioral norms, and a "public choice" model emphasizing the role of actors below the state that may use R&D-related policies as a way to extract rents. To be sure, our analysis does not imply that the underinvestment hypothesis is categorically false. Rather, our analysis limits the underinvestment hypothesis's scope—and thus focuses attention on areas in which international coordination will be most essential to knowledge production.[24]

Part III is where international IP treaties enter the narrative. Nation-states have chosen to use international IP laws as a means of addressing the underinvestment problem. The harmonization hypothesis posits that coordination of IP at the international level necessarily leads states to use IP at the domestic level. In Part III, we challenge that view. We develop the claim that international and domestic innovation policy are separable. True, TRIPS and other international IP agreements require signatory states to establish copyright and patent systems that meet minimum standards. Moreover, international IP agreements obligate signatory states to treat citizens of other signatories at least as favorably as their own citizens. But these agreements still allow individual states to adopt alternative (non-IP) arrangements for both the provision and allocation of knowledge goods at the domestic level. Our analysis also adds a new insight to the contentious debate over the Bayh-Dole Act and similar arrangements abroad, which allow grant recipients to patent their publicly funded inventions.[25] We explain that Bayh-Dole regimes have the overlooked benefit of allowing nation-states to internalize some of the foreign benefits of their non-IP investments in innovation, thereby increasing incentives for such investments in the first place.[26]

24. For example, given the differing public choice dynamics in the patent and copyright contexts, we think global underinvestment is far more likely to be a problem for technical rather than creative works.

25. *See infra* notes 170, 177–82 and accompanying text.

26. We discuss this theory in more detail in a separate article. Daniel J. Hemel & Lisa Larrimore Ouellette, Bayh–Dole Beyond Borders (Aug. 19,

Part IV then critiques the uniqueness hypothesis—the claim that IP is the only mechanism for incentivizing innovation that can be scaled to the global level. While it is true that there is no global public finance system, there is also no global court system for enforcing IP rights. To be sure, treaties such as TRIPS have set up institutions for resolving cross-border IP disputes, but one can imagine similar structures with respect to other innovation-incentive mechanisms. Rather than relying on the uniqueness hypothesis to justify the international IP regime, we argue that the most compelling justification for IP treaties is that they give each state some freedom to choose the domestically optimal set of innovation incentives and allocation mechanisms while also ensuring that production costs will be shared among states in rough proportion to the benefits they derive from knowledge goods. Moreover, the international IP regime effectively caps the size of transfers from consumer nation-states to producer nation-states: no state must pay for knowledge goods it does not use, and no state must pay more than the sum total of the benefits that accrue to its citizens. Counterintuitively, the strongest arguments in favor of the international IP regime may rest on grounds of domestic autonomy and distributive justice[27]—the very grounds on which international IP laws are commonly criticized.[28]

2016) (unpublished manuscript) (on file with authors).

27. This is not a defense of the current global distribution of the costs of knowledge goods; we would favor broadening the current TRIPS exemption for least-developed countries. But we think the current system sets a reasonable framework for transfers among wealthier countries, and it is not obvious that poor countries would fare better under a non-IP coordination system (indeed, they might fare much worse).

28. *See, e.g.*, ACCESS TO KNOWLEDGE IN THE AGE OF INTELLECTUAL PROPERTY (Gaëlle Krikorian & Amy Kapczynski eds., 2010) (describing the "access to knowledge movement" and various criticisms of international IP); MADHAVI SUNDER, FROM GOODS TO A GOOD LIFE: INTELLECTUAL PROPERTY AND GLOBAL JUSTICE 173–99 (2012) (criticizing the approach to patents put in place by TRIPS because it limits access to life-saving technological discoveries); Margaret Chon, *Intellectual Property and the Development Divide*, 27 CARDOZO L. REV. 2821, 2832 (2006) ("Over-reliance on utility-maximization ignores distributional consequences."); Laurence R. Helfer, *Human Rights and Intellectual Property: Conflict or Coexistence?*, 5 MINN. INTELL. PROP. REV. 47, 51–57 (2003) (discussing human rights concerns surrounding TRIPS); Amy Kapczynski, *Harmonization and Its Discontents: A Case Study of TRIPS Implementation in India's Pharmaceutical Sector*, 97 CALIF. L. REV. 1571, 1571–74 (2009) (stating that "[t]he most acute criticisms of the [international IP] trend have focused on the potential impact of TRIPS on health" and studying how practical considerations limit countries' autonomy to make use of the flexibilities built into TRIPS).

Finally, we consider the implications of our argument for the debate over domestic innovation incentives. A common concern regarding non-IP incentives is that states that subsidize the production of knowledge goods through non-IP channels cannot claim partial compensation from other consumer states. For example, Suzanne Scotchmer described the efficiency gains from IP treaties while lamenting the result of "too much intellectual property" relative to non-IP incentives.[29] But as we show, nation-states that subsidize innovation through prizes, grants, and tax credits can internalize the benefits conferred upon foreign consumers to the same extent as states that rely on IP. The international IP regime—perhaps surprisingly—serves as a mechanism through which nation-states can recoup some of the positive externalities that they generate through non-IP investments. Thus our (qualified) defense of the international IP regime is not an argument for reliance on IP at the domestic level. To the contrary, our observations regarding international IP suggest that innovation policy possibilities at the domestic level are broader than is often believed.

I. IP TREATIES AS THE SOLUTION TO A GLOBAL PUBLIC GOODS PROBLEM

This Part sets forth a conventional economic account of IP treaties as the solution to a global public goods problem. We begin in Part I.A with the problem of producing knowledge on the global scale. Part I.B then describes the relative substitutability of IP and non-IP innovation incentives from the perspective of a single nation-state. Part I.C explains how states have settled on IP treaties as a solution to this global public goods problem. Finally, Part I.D restates this account in a formal economic model.

A. THE GLOBAL CHALLENGE: UNCOMPENSATED EXTERNALITIES AND FREE-RIDING

As we explained in the Introduction, the same public-goods nature of knowledge goods that justifies state subsidies in the first place also implies that nation-states cannot solve the knowledge-goods problem on their own. Rational, self-interested nation-states will subsidize knowledge production only up to the point that the marginal cost equals the marginal benefit to their own citizens, without accounting for the bene-

29. Scotchmer, *supra* note 23.

fits of domestic knowledge production in other states. Thus, discussions of international IP law often begin with a similar story of externalities as the one that justifies domestic IP laws, except that it is states rather than private firms that fail to optimally invest in producing knowledge goods.[30]

There are at least two distinct accounts of why global investment in knowledge goods will be suboptimal, and the two accounts are worth teasing apart (for reasons that will become apparent below).[31] Under the first account, which we will refer to as the "free-rider problem," each state strategically considers the likely actions of others in setting its own knowledge-good subsidies. As explained by economists Gene Grossman and Edwin Lai, in "a trading world with many countries, . . . allow[ing] others to provide the incentives for innovation . . . avoid[s] the deadweight losses in . . . home markets."[32] In other words, there are some global public goods for which the payoffs seem to present a multi-player prisoners' dilemma, with each nation-state having an incentive to free-ride on the production of that good

30. *See, e.g.*, FREDERICK M. ABBOTT ET AL., INTERNATIONAL INTELLECTUAL PROPERTY IN AN INTEGRATED WORLD ECONOMY 93 (2007) (beginning the section on "Policies Underlying the International IPRs System" with Joseph Stiglitz's argument that knowledge is a global public good); MARGO A. BAGLEY ET AL., INTERNATIONAL PATENT LAW AND POLICY 19, 21 (2013) (stating that the "dominant justification for strong global intellectual property rights" is based on efficient international trade, in that if "China winks at piracy of computer programs and compact discs" then "much less incentive exists to produce the product in the first place"); PAUL GOLDSTEIN & MARKETA TRIMBLE, INTERNATIONAL INTELLECTUAL PROPERTY LAW: CASES AND MATERIALS 97 (3d ed. 2012) (noting the conventional argument "that worldwide research and development investment probably falls short of its socially optimal level, and that weak protection of intellectual property rights in developing countries aggravates this important problem," but questioning whether "developing countries should pay the price for increased" IP protection). In the earliest (pre-TRIPS) extended economic treatment of international patent agreements, Edith Penrose noted that they are beneficial only to the extent they increase innovation, though she was skeptical at that time that foreign patents would provide much incentive to innovators. EDITH TILTON PENROSE, THE ECONOMICS OF THE INTERNATIONAL PATENT SYSTEM 127–29 (1951).

31. *See infra* notes 226–32 and accompanying text.

32. Grossman & Lai, *supra* note 5, at 1650; *see also* Martin J. Adelman & Sonia Baldia, *Prospects and Limits of the Patent Provision in the TRIPS Agreement: The Case of India*, 29 VAND. J. TRANSNAT'L L. 507, 510 (1996) ("[S]ince patents are territorial, some countries may decide that they can win by free-riding on the patented technology developed elsewhere without substantially slowing the march of technological development. In this way, their societies are advantaged, although if everybody adopted this strategy, societies worldwide would lose out as technological advancement slowed.").

by other states.[33] In such circumstances, Grossman and Lai conclude, "a patent treaty is critical for creating incentives for private innovation."[34]

This is not to say that trade necessarily leads nation-states to invest less in knowledge production. While the possibility that knowledge goods will move across borders may give rise to the risk of free-riding, it also may increase the marginal benefit of additional investment in R&D. This is so even if producer states have no way to recapture the benefits from knowledge goods consumed elsewhere. Access to knowledge generated by Japanese researchers likely increases the productivity of U.S. researchers (and vice versa). When the United States decides whether to invest in a particular project, the movement of knowledge goods across borders has two countervailing effects. On the one hand, the payoff from such investment may be larger when U.S. researchers can stand on the shoulders of giants elsewhere. On the other hand, the United States may have an incentive to step back and allow other countries to take the lead.

The free-rider account is distinct from a second account of underinvestment in IP: the "uncompensated externalities problem." This problem arises when each nation-state sets its subsidies for knowledge-good provision independently and non-strategically, but still fails to account for positive externalities generated by its own innovation effort. For example, the United States might invest in cancer research up to the point that the marginal benefits to U.S. cancer patients (present and future) equal the marginal costs, without considering the benefits to cancer patients in other countries as well. If the United States were to consider the benefits to patients abroad when deciding how much to invest in cancer research, then presumably the United States would invest more. Economist Suzanne Scotchmer emphasized that "uncompensated externalities abroad"—benefits to consumers in other countries from a state's own knowledge production efforts—mean that states "have deficient incentives to invest, relative to what is effi-

33. For the payoffs to resemble a prisoners' dilemma, all that is necessary is that the cost to an individual country of producing the good is greater than the benefit to that country but less than the global benefit. *See Prisoners' Dilemma*, 3 ROUTLEDGE ENCYCLOPEDIA OF INTERNATIONAL POLITICAL ECONOMY 1271–72 (R.J. Barry Jones ed., 2001).

34. Grossman & Lai, *supra* note 5, at 1650.

cient."[35] Similarly, in the legal literature, John Duffy has argued that the problem of uncompensated externalities "provide[s] a particularly powerful justification for transnational patent harmonization."[36] (As discussed further below, we think this account is largely accurate insofar as knowledge goods are global public goods and nation-states seek to maximize absolute gains, though we also note the account's limits.)

Of course, both effects can occur simultaneously: a nation-state may underinvest in the provision of a particular knowledge good both because it fails to account for external benefits and because it expects to free-ride off the provision of that knowledge good by its neighbor.[37] But we think it is worth explicitly disentangling these accounts because they will apply in different situations, and they lend themselves to different solutions.[38] For now, however, the important point is that under the standard economic account, nation-states will underinvest in knowledge-good provision unless they can find some way to coordinate their efforts.

B. CHOICES IN STATE SUPPORT FOR KNOWLEDGE PRODUCTION

Introductory IP casebooks often begin by explaining that patent and copyright laws increase incentives for information production, and thus allow for more efficient provision of knowledge goods by the private sector.[39] As IP scholars have

35. Scotchmer, *supra* note 23, at 420.

36. John F. Duffy, *Harmony and Diversity in Global Patent Law*, 17 BERKELEY TECH. L.J. 685, 695 (2002).

37. Scholars of international IP sometimes mention both effects without distinguishing them. *See, e.g.*, Keith E. Maskus & Jerome H. Reichman, *The Globalization of Private Knowledge Goods and the Privatization of Global Public Goods*, 7 J. INT'L ECON. L. 279, 285 (2004) (mentioning uncompensated externalities and the choice of countries to "logically free ride on foreign R&D" as part of the same "main reason" that "countries would tend to protect new technology and product development at a level that is lower than would be globally optimal").

38. *See infra* notes 226–29 and accompanying text.

39. *See, e.g.*, PAUL GOLDSTEIN & R. ANTHONY REESE, COPYRIGHT, PATENT, TRADEMARK AND RELATED STATE DOCTRINES 18–20 (7th ed. 2012); ROBERT P. MERGES ET AL., INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE 12 (6th ed. 2012) (describing the public-good nature of knowledge as a justification for awarding IP rights has a long history); JEREMY BENTHAM, *A Manual of Political Economy*, *in* 3 THE WORKS OF JEREMY BENTHAM 31, 71 (John Bowring ed., 1843), http://oll.libertyfund.org/titles/1922 ("He who has no hope that he shall reap, will not take the trouble to sow. But that which one man has invented, all the world can imitate. Without the assistance of the laws, the inventor would almost always be driven out of the market . . . .").

realized, there are a number of caveats to this account. Most obviously, IP sacrifices static efficiency for dynamic efficiency. IP increases the production of knowledge goods by making them more excludable, thereby increasing dynamic efficiency, but this benefit comes at the cost of pricing nonrivalrous goods above their marginal cost of zero, which reduces static efficiency.[40] Information is also rarely a pure public good. Knowledge goods are often excludable even without IP,[41] and many such goods will be provided without state action,[42] particularly as the costs of production plummet in many industries.[43] Furthermore, creating property rights in information is only one of many

40. *See* Oren Bracha & Talha Syed, *Beyond the Incentive–Access Paradigm? Product Differentiation & Copyright Revisited*, 92 TEX. L. REV. 1841, 1849–50 (2014) (arguing that IP should thus be described as addressing only an "appropriability problem" rather than a "public goods problem"). A good is nonexcludable if no one can be excluded from its benefits, and it is nonrivalrous if its consumption by one user does not detract from its utility for other users (that is, there is zero marginal cost to consumption). *See* PAUL KRUGMAN ET AL., ESSENTIALS OF ECONOMICS 279 (2d ed. 2010). If a good is nonexcludable but rival (e.g., common pool resources such as biodiversity), consumers can free-ride on anyone who does pay, leading to "inefficiently low production." *Id.* at 280. If a good is nonrivalrous but excludable (e.g., pay-per-view movies), private firms can profit by supplying it, but setting a price greater than zero leads to "inefficiently low consumption." *Id.*

41. *See* Amy Kapczynski & Talha Syed, *The Continuum of Excludability and the Limits of Patents*, 122 YALE L.J. 1900, 1903 (2013). Although Kapczynski and Syed frame their discussion as a critique of patents, we see no a priori reason to believe that patents increase the variance in the fraction of social value that inventors can capture. In the absence of patents, inventors could still resort to secrecy, and patents can level the playing field between inventions that are easy to keep secret and those that are not. There is less variability in information's nonrivalrousness, but some information may decrease in value with use. *See* William M. Landes & Richard A. Posner, *Indefinitely Renewable Copyright*, 70 U. CHI. L. REV. 471, 487–88 (2003) (arguing that if anyone could use Mickey Mouse, "the value of the character might plummet" because the public would "rapidly tire of" him and "his image would be blurred"); Kevin Outterson, *The Vanishing Public Domain: Antibiotic Resistance, Pharmaceutical Innovation and Intellectual Property Law*, 67 U. PITT. L. REV. 67 (2005) (describing antibiotic resistance, which seems to us a clear example of rival patentable knowledge).

42. *See, e.g.*, KAL RAUSTIALA & CHRISTOPHER SPRIGMAN, THE KNOCKOFF ECONOMY: HOW IMITATION SPARKS INNOVATION (2012) (describing industries in which innovation has flourished with relatively little state intervention); Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257 (2007) (describing the social benefits of non-internalized spillovers). But there is little serious challenge to the claim that many knowledge goods will not be produced without some state-facilitated transfer to the producer, and our argument is focused on those cases.

43. *See generally* YOCHAI BENKLER, THE WEALTH OF NETWORKS 99–106 (2006) (describing the development of free software products).

ways to compensate providers of knowledge goods. Alternatively, states can subsidize the production of knowledge goods through prizes, grants, and tax incentives (such as tax credits for R&D and special deductions for qualified artists).[44]

In previous work, we have analyzed the advantages and disadvantages of these various mechanisms from the perspective of a single nation-state.[45] We explained that no one incentive (or mix of incentives) strictly dominates for all forms of knowledge production; rather, optimal innovation policy is context specific. IP is particularly well suited to cases in which capital markets operate efficiently, potential innovators are risk-neutral, and the relevant knowledge good is considered a luxury. In all cases, the choice of innovation incentive will depend on the nature of the knowledge goods in question and on the society's goals and distributional preferences.[46]

44. Performing artists can claim a deduction for unreimbursed expenses even when they take the standard deduction, while employees in most other lines of work only can claim a deduction for unreimbursed employee expenses if they itemize deductions on their tax returns. *See* 26 U.S.C. §§ 62(a)(1), (a)(2)(B) (2012).

45. Hemel & Ouellette, *supra* note 3. Although our prior work focused on incentives for patentable knowledge, our framework also applies to other knowledge goods such as artistic works, though the dimensions of our framework suggest that optimal incentives will look very different for most creative works than for technical inventions. For an example of a tax incentive for creative works, see 26 U.S.C. § 62(a)(2), which allows deductions for a "qualified performing artist." For federal grant opportunities for artists, see *Grants*, NAT'L ENDOWMENT FOR THE ARTS, https://www.arts.gov/grants (last visited Oct. 13, 2016). Governments also use tax incentives to support movie production. *See, e.g.*, Paul Krekorian, *To Keep 'Hollywood' in Hollywood, Tax Incentives Are Key*, L.A. TIMES (July 13, 2014), http://www.latimes.com/opinion/op-ed/la-oe-krekorian-film-tax-credit-20140714-story.html; Etan Vlessing, *Mark Wahlberg to Canada: Restore Film Tax Breaks for Hollywood*, HOLLYWOOD REP. (Dec. 5, 2012), http://www.hollywoodreporter.com/news/mark-wahlberg-canada-restore-film-398637; *see also infra* note 69 (noting other grants and tax incentives for the arts).

46. In short, we argued that every state transfer to spur knowledge production embodies the answers to three questions: (1) *Who decides* the size of the transfer? Does the state tailor the reward on a project-by-project basis (as with direct spending and fixed prizes)? Or does it simply establish technology-neutral ground rules (as with IP and tax incentives), which leverage private information about potential projects? (2) *When* does the transfer occur? Only ex post to successful projects (as with prizes and IP), providing a strong incentive for success? Or are projects funded before their results are known (as with grants and tax incentives), which might be more effective when producers are risk averse and capital constrained? (3) *Who pays*? Do all taxpayers fund the transfer (as with grants, prizes, and tax incentives), or only users of the resulting information (as with IP)? We argue that whether "user pays" is normatively attractive will vary with the technology, and that in theory, "user pays"

From the perspective of the state, one of the key distinctions between IP and other knowledge-production incentives is that IP-mediated transfers to artists and innovators are for the most part not reflected in government budgets. The higher prices on IP-protected goods can be considered a "shadow" tax—equivalent to a targeted sales tax on these goods—and IP laws can be viewed as "shadow" expenditures that transfer these rewards to producers.[47]

The other mechanisms, in contrast, are funded through conventional public finance. From the consumer's perspective, of course, there is little difference between paying $100 in higher prices on IP-protected products and paying $100 in higher taxes that are used to fund mechanisms such as prizes, grants, and tax credits.[48] But the interchangeability of IP and other transfer mechanisms depends on the existence of a state that can use conventional public finance mechanisms. In the global context, there is no single worldwide governance body that has authority to impose taxes, and thus no straightforward way to replicate the effect of IP through a tax-and-spend regime.

C. THE IP SOLUTION

In theory, nation-states could address the problem of underinvestment in knowledge goods by coordinating on any of the mechanisms discussed in Part I.B. In practice, however, IP has emerged as the primary solution to this global coordination dilemma. In the conventional economic account, treaties such as TRIPS help solve the underprovision problem by requiring states to bear the costs of knowledge production to the extent that they use knowledge goods produced under IP laws.

Efforts at multilateral coordination on IP date to the 1880s, when numerous nations negotiated the Berne Convention on copyright law and the Paris Convention on patent and trademark law, which are administered by an organization now

could be incorporated into other reward mechanisms. Hemel & Ouellette, *supra* note 3, at 327–52.

47. *Id.* at 312–13, 371–73.

48. As currently implemented, non-IP incentives tend to be funded through broad-based taxation in which users cross-subsidize each others' knowledge goods, but as we've explained, this is a distinct third dimension in innovation policy space. *Id.* at 327–52. The administrative costs of each system also will vary with implementation; for estimates of current costs in the United States see *id.* at 361–67.

known as the World Intellectual Property Organization (WIPO).[49] These agreements required some minimum level of IP protection (e.g., the Berne Convention set a minimum copyright term of life-of-the-author plus fifty years),[50] and they established the norm of "national treatment"—that every member must give nationals of other members treatment no less favorable than their own.[51] As Graeme Dinwoodie notes, "This basic structure—national treatment plus substantive minima—has persisted throughout the twentieth century," with the minimum IP standards gradually being "revised upwards" from their initially "undemanding" levels.[52]

The most significant upward revision came when TRIPS was negotiated in 1994 through the World Trade Organization (WTO).[53] The heightened standards of TRIPS must be met by every WTO member nation, which now includes most of the world (including every high-income country).[54] For example, TRIPS requires countries to offer twenty-year patents "in all fields of technology" and to have trade secret laws that protect certain "undisclosed information."[55] More recently, countries including the United States have pushed for further increases in global IP protection through bilateral and multilateral agreements, including the Anti-Counterfeiting Trade Agreement (ACTA), signed in 2011 (but then rejected by the European Parliament), and the Trans-Pacific Partnership (TPP), on which participants reached agreement in October 2015 after conten-

49. Berne Convention for the Protection of Literary and Artistic Works, Sept. 9, 1886, 25 U.S.T. 1341, 1161 U.N.T.S. 3 (revised July 24, 1971), S. TREATY DOC. No. 99-27 [hereinafter Berne Convention]; Paris Convention for the Protection of Industrial Property, Mar. 20, 1883, 21 U.S.T. 1583, 828 U.N.T.S. 303 (revised July 14, 1967) [hereinafter Paris Convention]; *see WIPO—A Brief History*, WORLD INTELL. PROP. ORG., http://www.wipo.int/about-wipo/en/history.html (last visited Oct. 16, 2016).

50. Berne Convention, *supra* note 49, art. 7(1).

51. *Id.* at art. 5(1); Paris Convention, *supra* note 49, art. 2(1).

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

53. TRIPS, *supra* note 14. For an account of how nation-states jockey for favorable forums for IP treaty negotiations—and an important reminder of how messily economic theories play out in the real world—see Laurence R. Helfer, *Regime Shifting: The TRIPs Agreement and New Dynamics of International Intellectual Property Lawmaking*, 29 YALE J. INT'L L. 1 (2004).

54. *See Members and Observers*, *supra* note 14.

55. TRIPS, *supra* note 14, arts. 27(1), 33, 39. For an overview of other changes, see J.H. Reichman, *Universal Minimum Standards of Intellectual Property Protection Under the TRIPS Component of the WTO Agreement*, 29 INT'L L. 345 (1995).

tious negotiations (but which may still fail during ratification).[56]

To be sure, not all scholars agree that the upward ratcheting of IP protection under TRIPS and other agreements has been a positive development. TRIPS has been criticized for impeding access to knowledge and development,[57] for having been unfairly imposed on developing countries,[58] and for limiting policy experimentation and regulatory competition.[59] Some commentators have argued that TRIPS should be supplemented or replaced by different global R&D agreements. For example, Joseph Stiglitz has argued that "basic research and many other fundamental forms of knowledge are not, and almost certainly should not be, protected by an intellectual property regime," and therefore "[i]n these areas efficiency requires public support," which "must be at the global level."[60] There have also been calls for supplemental R&D treaties in the public health[61]

56. *See* Susan K. Sell, *TRIPS Was Never Enough: Vertical Forum Shifting, FTAs, ACTA, and TPP*, 18 J. INTELL. PROP. L. 447 (2011).

57. *See* Kapczynski, *supra* note 28, at 1571–72.

58. *See, e.g.*, SELL, *supra* note 15, at 9–10; Donald P. Harris, *TRIPS and Treaties of Adhesion Part II: Back to the Past or a Small Step Forward?*, 2007 MICH. ST. L. REV. 185, 199–200.

59. *See, e.g.*, GRAEME B. DINWOODIE & ROCHELLE C. DREYFUSS, A NEOFEDERALIST VISION OF TRIPS: THE RESILIENCE OF THE INTERNATIONAL INTELLECTUAL PROPERTY REGIME 115 (2012); Duffy, *supra* note 36, at 721; Lisa Larrimore Ouellette, *Patent Experimentalism*, 101 VA. L. REV. 65, 86 (2015).

60. Joseph E. Stiglitz, *Knowledge as a Global Public Good*, *in* GLOBAL PUBLIC GOODS: INTERNATIONAL COOPERATION IN THE 21ST CENTURY 308, 320 (Inge Kaul et al. eds., 1999).

61. Tim Hubbard and James Love advocate an "R&D contribution norm, established by treaty." Hubbard & Love, *supra* note 16, at 150. Under the Health Impact Fund proposed by Aidan Hollis and Thomas Pogge, pharmaceutical manufacturers could opt in to a global prize scheme, for which they propose a minimum funding level of $6 billion (allocated based on gross national income). AIDAN HOLLIS & THOMAS POGGE, THE HEALTH IMPACT FUND: MAKING NEW MEDICINES ACCESSIBLE FOR ALL 44 (2008), http://www.healthimpactfund.org/Old/hif_book.pdf. For similar arguments in favor of a global health R&D treaty, see Nicoletta Dentico & Nathan Ford, *The Courage To Change the Rules: A Proposal for an Essential Health R&D Treaty*, PLOS MED., Feb. 2005, at 96; Suerie Moon et al., *Innovation and Access to Medicines for Neglected Populations: Could a Treaty Address a Broken Pharmaceutical R&D System?*, PLOS MED., May 2012, at 1. Movement toward a global health R&D treaty at the World Health Organization has been unsuccessful. *See* CONSULTATIVE EXPERT WORKING GRP. ON RESEARCH & DEV., WORLD HEALTH ORG., RESEARCH AND DEVELOPMENT TO MEET HEALTH NEEDS IN DEVELOPING COUNTRIES: STRENGTHENING GLOBAL FINANCING AND COORDINATION (2012), http://www.who.int/phi/CEWG_Report_5_April_2012.pdf (recommending a

and climate[62] arenas. But these critiques generally do not challenge the dominant narrative that international coordination is necessary; rather, they argue for non-IP forms of collective action. Stiglitz is clear, for instance, that "[k]nowledge is a global public good" and that "global public goods provide a central rationale for international collective action."[63]

Despite these critiques of TRIPS and calls for global R&D treaties, IP might seem like the most natural solution to the collective-action problem facing nation-states because there is no world government that can set global taxes to support conventional public finance mechanisms. Scotchmer argued that states coordinate on IP due to the lack of "institutions to harmonize public spending."[64] She elaborated that "[t]here is no analogous institution [to IP treaties] for making public sponsors account for cross-border spillovers."[65]

Scotchmer was not, however, pleased with what she saw as the inevitable implication of this necessary global coordination on IP, which she summarized as follows:

> [H]armonization [of global IP laws] will not solve all the efficiency problems that arise from independent policy making. Perhaps the most important problem arises when we recognize that for some investments, public spending is the most efficient way to fund R&D. . . . But since public funding agencies will not be inclined to take account of benefits generated abroad, the incentives to provide public spending will be deficient. In contrast, harmonized intellectual property protections allow countries to recoup some of the benefits they confer on foreign consumers. This may lead to an international system that relies more heavily on intellectual property than is efficient, especially when it is recognized that public spending on R&D is an extensive and efficient practice.[66]

In sum, the account of global IP treaties presented above proceeds as follows: Knowledge is a global public good, so nation-states will rationally underinvest in its production unless there is coordination at the global level (which we refer to as the "underinvestment hypothesis"). Global coordination on IP

binding instrument for health R&D funding); Kiddell-Monroe et al., *supra* note 18 (describing the derailment of this process).

62. *See, e.g.*, Scott Barrett, *Climate Treaties and "Breakthrough" Technologies*, 96 AM. ECON. REV. 22, 25 (2006); Daniel Bodansky, *Climate Commitments: Assessing the Options*, *in* BEYOND KYOTO 37, 43 (Joseph E. Aldy et al. eds., 2003); Heleen de Coninck et al., *International Technology-Oriented Agreements To Address Climate Change*, 36 ENERGY POL'Y 335, 348 (2008).

63. Stiglitz, *supra* note 60, at 320.

64. Scotchmer, *supra* note 23.

65. *Id.* at 420.

66. *Id.* at 436.

dictates how states incentivize innovation and allocate knowledge goods domestically, leading to reliance on IP at the expense of other mechanisms such as prizes, grants, and tax credits (the "harmonization hypothesis"). And IP is the only plausible solution for this collective-action problem due to the lack of a global public finance system to support other mechanisms such as grants, prizes, and tax incentives (the "uniqueness hypothesis").

In the following three Parts, we argue that each step of this logic is incomplete. But first, we restate the classical economic account in formal terms so that each step in the logic can be rendered more precise.

D. A FORMAL ECONOMIC MODEL

We begin with a rudimentary model featuring some number of states—S_A, S_B, S_C, and so on—each of which is a potential producer and potential consumer of knowledge goods. Let x be the level of investment in production of the relevant knowledge good. Let $B_A(x)$ be the benefit to consumers in S_A from investment of x in the relevant good assuming that the good is freely available to consumers in S_A; let $B_B(x)$ be the benefit to consumers in S_B from investment of x in the good (again assuming free availability), and so on, such that B_{global} is the sum of all Bs for all nation-states. Finally, let $C(x)$ represent the cost of investing x. Assume that investment in the production of the knowledge good is subject to the law of diminishing marginal returns, such that $B'(x) > 0$ and $B''(x) < 0$.

From a global welfare perspective, the optimal level of investment (x_{global}^*) occurs when $B_{global}'(x_{global}^*) = C'(x_{global}^*)$, which is when the marginal benefit from any additional investment equals the marginal cost. However, S_A only has an incentive to invest up to x_A^* such that $B_A'(x_A^*) = C'(x_A^*)$. If $B_A < B_{global}$, then $x_A^* < x_{global}^*$. S_A may even invest less than x_A^* if it suspects that it can rely on investments by other countries, but if B_A is the largest B_i, no individual country will have an incentive to increase total global investment beyond x_A^*. Total global investment will thus be below the global optimum.

States can address this inefficiency by establishing a mechanism whereby consumer states will compensate S_A when a knowledge good produced in S_A is consumed elsewhere. So, for example, if diabetes patients in S_B benefit from a good generated in S_A, the patients or the government of S_B will make a payment to an S_A-based firm. (The payment will go directly to the

government of S_A if the relevant patent is state-owned; otherwise, the government of S_A will claim a portion of the payment through taxation of the firm.) Let $T_{B \to A}$ represent the transfer payment that S_B (or its citizens) makes to S_A (or an S_A-based firm) as partial compensation to S_A for developing the relevant knowledge good.

The international IP regime serves as a mechanism for setting $T_{B \to A}$. If a knowledge good is produced in S_A and demand for the good exists among S_B's citizens, S_B cannot simply appropriate the knowledge good for its own use; it must compensate S_A. In the absence of a licensing agreement, S_B must allow S_A to sell the knowledge good to consumers in S_B at a monopoly price (the monopoly being conferred by IP law). Let $P_{B|monopoly}$ be the profits that S_A (or the S_A-based firm) will earn from selling the knowledge good at a monopoly price in S_B, and let $B_{B|monopoly}(x)$ be the benefit to consumers in S_B from access to the good at a monopoly price. Absent perfect price discrimination, some consumers in S_B who could benefit from the good will be unwilling or unable to pay the monopoly price; thus, $B_{B|monopoly}(x) < B_B(x)$, and $T_{B \to A} = P_{B|monopoly} < B_{B|monopoly}(x)$. If the S_A-based firm can price-discriminate perfectly, then $T_{B \to A} = P_{B|monopoly} = B_{B|monopoly}(x) = B_B(x)$.

We return to this model below. But before doing so, we interrogate key assumptions underlying the model—namely, that states are rational actors and that knowledge goods are global public goods.

II. WHY DO NATION-STATES INVEST IN KNOWLEDGE PRODUCTION?

The public-goods framework presented in Part I predicts that without an international coordination mechanism, nation-states will underinvest in knowledge goods. Testing this prediction is virtually impossible: to say that states "underinvest" in knowledge goods, we would have to know the optimal amount of public investment in knowledge goods. That amount is, of course, unknown (and likely unknowable). Moreover, the underinvestment hypothesis generated by the public-goods framework is not falsified by the fact that states *do* invest in information production beyond what international agreements require; after all, the public-goods framework predicts underinvestment rather than no investment.

We can observe that in practice, there are tremendous state transfers to information producers beyond what is re-

quired by international law. In 2010, for instance, the governments of seven countries—the United States, France, Germany, the United Kingdom, China, Japan, and South Korea—spent more than $272 billion in the aggregate on direct R&D support (not including tax incentives).[67] This direct support for R&D comes on top of the indirect subsidy for R&D required by international IP law. Indeed, direct U.S. government support for R&D quite likely exceeds the size of the patent "shadow tax" in the United States.[68] Governments also spend significant sums to encourage creative works.[69] Again, this does not disprove the underinvestment hypothesis, but it may cause one to question whether the conventional economic account fully captures the reasons why states invest in innovation.

Recall that the underinvestment hypothesis rests on two premises: (1) knowledge is a global public good; and (2) nation-states rationally underinvest in global public goods. While we cannot test the underinvestment hypothesis by comparing actual investment to optimal investment (because we cannot determine the latter figure), we can evaluate the robustness of

67. *See* NAT'L SCI. FOUND., SCIENCE AND ENGINEERING INDICATORS 2014 app. at tbl.4-14, http://www.nsf.gov/statistics/seind14/content/chapter-4/at04-14.pdf.

68. *See* Hemel & Ouellette, *supra* note 3, at 320–21, 322–25, 371–72 (noting as of 2013 that the federal government spends in the range of $140–$150 billion per year on R&D and R&D-related tax incentives, more than double the estimated amount of domestically earned corporate income from patents and trade secrets).

69. In the mid-1990s, direct public expenditure on the arts in the United States was about $1.5 billion per year, which was substantially less per capita than in many other industrialized nations: Germany spent $6.9 billion, France spent $3.3 billion, the United Kingdom spent $1.5 billion, and Canada spent $1.3 billion. *See* NAT'L ENDOWMENT FOR THE ARTS, INTERNATIONAL DATA ON GOVERNMENT SPENDING ON THE ARTS 9, tbl.1 (Jan. 2000) http://www.arts.gov/sites/default/files/74.pdf. Classifying "the arts" is difficult; these estimates did not include spending on libraries, arts training, capital expenditures (e.g., building a new theater), or tax incentives. *Id.* at 2. Lea Shaver notes that public support for book provision includes support for universities that employ and train many authors, direct purchase of textbooks by education departments (or by students using public financial aid), and purchases of books by libraries—which alone costs taxpayers a billion dollars per year in the United States. Lea Shaver, *The Right To Read*, 54 COLUM. J. TRANSNAT'L L. 1, 51 (2015). Cultural production is also supported through tax incentives. *See* NAT'L ENDOWMENT FOR THE ARTS, HOW THE UNITED STATES FUNDS THE ARTS 18–24 (3d ed. 2012), http://www.arts.gov/sites/default/files/how-the-us-funds-the-arts.pdf; *see also supra* note 45 and accompanying text (discussing additional tax incentives).

the premises on which the hypothesis rests. We do so in this Part.

We have already noted that knowledge is rarely a pure public good.[70] In Part II.A, we consider the extent to which knowledge is in fact a *global* public good. We suggest that "globalness" is a matter of degree: while demand for some knowledge goods is dispersed across countries, demand for other knowledge goods is highly concentrated in one or a small number of locations. We also consider evidence that the production of knowledge goods yields positive local production externalities: in this respect, knowledge production is an activity that generates distinct local and global benefits. We argue that the strength of the underinvestment hypothesis varies with the dispersion of demand and the magnitude of positive local production externalities: when demand is highly concentrated and positive local production externalities are significant, nation-states will rationally invest in knowledge production at close to globally optimal levels.

In Part II.B, we examine the second premise on which the underinvestment hypothesis rests: the claim that nation-states—as self-interested rational actors—will underinvest in the production of global public goods. For decades, scholars of domestic and political economy have debated whether nation-states are in fact self-interested rational actors. One variant of the rational-actor model, "realism," posits that nation-states are engaged in a competition with each other for security, and that they seek to maximize relative (rather than absolute) gains. Realism is especially helpful for understanding state spending on knowledge goods related to national-security concerns (such as the substantial spending on the space race), but the realist approach also suggests that states may have incentives to invest in knowledge goods with no immediate defense application. An alternative to the rational-actor model, "constructivism," sees states as actors whose identities and interests are constructed by social interactions. In the constructivist model, states do not single-mindedly seek material gains; rather, their actions are shaped by behavioral norms, such as the norm that spending on science is something that states are "supposed to do." Finally, public choice theory (along with its international-political-economy cousin, "liberal intergovernmentalism") focuses on actors below the state, such as domestic in-

70. *See supra* notes 41–42 and accompanying text.

terest groups that may seek to extract rents through R&D-related policies.

Unsurprisingly, these different perspectives yield different conclusions as to why states invest in knowledge production—and different predictions as to whether investment will approach optimal levels. However, they all suggest that the conventional account in the IP literature overlooks important dimensions of the knowledge-production problem. This is not to imply that international IP treaties are unnecessary; rather, our analysis of the underinvestment hypothesis is aimed at identifying the conditions under which the conventional economic account will be most applicable.

A. IS KNOWLEDGE A GLOBAL PUBLIC GOOD?

As noted above, the underinvestment hypothesis proceeds from the premise that knowledge is a global public good. A global public good, like other public goods, is nonrivalrous and nonexcludable.[71] The distinguishing feature of a *global* public good is that its benefits transcend national borders. IP scholars often state categorically that information and knowledge are global public goods.[72] In this Section, we examine the extent to which benefits from knowledge goods—benefits from consumption and from positive production externalities—are in fact global.

1. Dispersion of Demand

For some knowledge goods, demand is largely domestic. And with respect to these goods, the coordination challenges outlined in Part I are less daunting. Consider the cranberry. Over three-quarters of the world's cranberries are grown in the United States,[73] and nearly three-quarters of U.S.-grown cran-

71. *See* KRUGMAN ET AL., *supra* note 40.

72. *See, e.g.*, Dana Dalrymple, *Scientific Knowledge as a Global Public Good: Contributions to Innovation and the Economy*, *in* THE ROLE OF SCIENTIFIC AND TECHNICAL DATA AND INFORMATION IN THE PUBLIC DOMAIN 35, 36 (2003); Lea Shaver, *The Right to Science and Culture*, 2010 WIS. L. REV. 121, 156 ("[R]ecent scholarship in economics and law . . . identifies knowledge as a global public good . . . ."); Joseph E. Stiglitz, *Economic Foundations of Intellectual Property Rights*, 57 DUKE L.J. 1693, 1714 (2008) ("[K]nowledge is a global public good . . . .").

73. *See FAOStat*, FOOD & AGRIC. ORG. OF THE UNITED NATIONS, http://faostat3.fao.org/browse/Q/QC/E (select "Cranberries") (last visited Oct. 13, 2016).

berries are consumed domestically.[74] So questions related to the health effects of cranberries are primarily of concern to U.S. producers and consumers—other countries that don't produce or consume cranberries in significant quantities have much less interest in the issue.[75] Unsurprisingly, the United States is the only country that has invested significantly in cranberry-related R&D: the U.S. National Institutes of Health has targeted cranberry-related research as a funding priority since 2005.[76] Cranberry-related knowledge appears to be nonrivalrous and nonexcludable (so technically a public good); but with only the United States (and, to a lesser extent, Canada) having a significant stake in the issue, cranberry-related R&D does not pose a major international coordination challenge.[77]

Other examples are not hard to come by. Roughly three-quarters of the world's tornados occur in the United States,[78] so lack of international coordination with respect to tornado-related R&D is probably not a significant problem (even though tornado-related knowledge probably is nonrivalrous and nonexcludable). Moyamoya disease occurs primarily in the Japanese population—Japan has over fifty times as many cases as the rest of the world combined[79]—so it is unlikely that global coordination challenges will lead the Japanese government to underinvest in Moyamoya-disease-related research. Indeed,

74. *See* Tom Moroney & Brian K. Sullivan, *U.S. Cranberry Growers Give Thanks as Sales Rise in Europe*, N.Y. TIMES (Oct. 22, 2006), http://www.nytimes.com/2006/11/22/business/worldbusiness/22iht-berry.3633021.html.

75. To be sure, if it turns out that cranberries have a large *positive* health effect such as curing cancer, then they might be more widely consumed. *See generally* SUSAN PLAYFAIR, AMERICA'S FOUNDING FRUIT: THE CRANBERRY IN A NEW ENVIRONMENT 14–16 (2014) (describing research on cranberries' cancer-fighting properties).

76. *See Programs and Projects*, UMASS DARTMOUTH CRANBERRY HEALTH RESEARCH CTR., http://www.umassd.edu/chrc/programsampprojects (last visited Oct. 13, 2016).

77. This does not mean that cranberries will have no economic effects outside the United States; foreign firms may choose to invest in the U.S. agricultural industry, perhaps at the encouragement of the U.S. government. Our point is simply that if demand for a knowledge good is geographically concentrated in one country, then the good does not present the same problem of uncompensated externalities discussed above.

78. *See* Kathryn Prociv, *From Domestic to International: Tornadoes Around the World*, U.S. TORNADOES (July 25, 2013), http://www.ustornadoes.com/2013/07/25/from-domestic-to-international-tornadoes-around-the-world.

79. *See* Yoshiharu Matshushima, *Moyamoya Disease*, *in* PRINCIPLES AND PRACTICE OF PEDIATRIC NEUROSURGERY 1053, 1053 (A. Leland Albright et al. eds., 1999).

knowledge goods of this type (we will call them "cranberry goods") might be the modal case. Most patent applicants only seek to patent in a single jurisdiction; for example, patent filing data suggests that about two-thirds of USPTO applications are only filed in the United States.[80] And even when the benefits of knowledge production are not as limited geographically, there are some challenges that are so important to a single country that the country's government is likely to take on the challenge itself rather than free-riding off the efforts of others (e.g., flood control in the Netherlands).[81]

Certain creative works may resemble the "cranberry good" prototype to an even greater degree. More than ninety-six percent of Swedish speakers live in Sweden,[82] so one might expect the government of Sweden to have an incentive to invest close to x_{global}* in Swedish-language literature and lyrical music. (To be sure, some Swedish-language books and songs may reach a much wider audience via translation. as Stieg Larsson and ABBA can attest.) The United Kingdom may have entirely adequate incentives to invest in the production of new recipes for steak and kidney pie[83] (though perhaps the case for global coordination is stronger with respect to the production of crime dramas starring Benedict Cumberbatch).

And for some creative works, the public goods framework is almost entirely inapplicable because the relevant knowledge is inextricably tied to a rivalrous and excludable good. (No two individuals can have the same original Jeff Koons balloon dog

80. *See* IP5 STATISTICS REPORT: 2014 EDITION 49 tbl.3 (2015), http://www.fiveipoffices.org/statistics/statisticsreports/2014edition/ip5sr2014.pdf (reporting that roughly sixty-six percent of U.S. applicants with a 2010 priority filing year did not file elsewhere, compared with fifty-seven percent for the European Patent Office, seventy-two percent for Japan, ninety-six percent for China, eighty-three percent for applicants in South Korea, and seventy-seven percent for applicants elsewhere). These figures might be explained in large part by the high cost of foreign filing and enforcement rather than the geographic concentration of demand. *See* MARKETA TRIMBLE, GLOBAL PATENTS: LIMITS OF TRANSNATIONAL ENFORCEMENT 35 (2012) (explaining why "obtaining parallel patents is . . . difficult and costly" and only feasible for large companies).

81. *See* Andrew Higgins, *Lessons for U.S. from a Flood-Prone Land*, N.Y. TIMES (Nov. 14, 2012), http://www.nytimes.com/2012/11/15/world/europe/netherlands-sets-model-of-flood-prevention.html (discussing Dutch preeminence in flood-related research).

82. *See Swedish*, ETHNOLOGUE, http://www.ethnologue.com/language/swe (last visited Oct. 13, 2016).

83. *See, e.g.*, Anthony Worall Thompson, *Steak and Kidney Pie*, BBC, http://www.bbc.co.uk/food/recipes/steakandkidneypie_73308 (last visited Oct. 13, 2016).

sculpture in their living room—unless they share a living room.)[84]

Global coordination is more essential with respect to knowledge goods for which demand is widely dispersed—think of information about earthquake dynamics or wind energy. In terms of rivalrousness and excludability, knowledge in these fields may be no different from knowledge about the treatment of Moyamoya disease and the tracking of tornados. But free-riding incentives are much stronger. The United States knows that it can rely on the results of earthquake-related research from Japan and wind-energy research from Germany. And Japan and Germany face a similar incentive structure. Moreover, even without opportunistic free-riding, the problem of uncompensated externalities remains. The United States will rationally invest in knowledge production up to the point that the marginal benefits (to the U.S.) equal the marginal costs, but the marginal benefits to the United States of wind energy-related knowledge represent only a fraction of the marginal global benefits; accordingly, the United States will set its investment level below the point at which marginal global benefits equal costs (and other countries will do the same).[85]

Based on a rational-actor model of state behavior, then, aggregate global investment in R&D will be closer to the socially optimal level with respect to knowledge goods for which demand is concentrated in one or a small number of industrialized nations. (When the demand for goods is localized only to developing countries that cannot afford to produce the goods, local knowledge goods may prove more difficult to finance than global knowledge goods.)[86] If the benefits of a knowledge good

84. *See* Katya Kazakina and Philip Boroff, *Koons's Puppy Sets $58 Million Record for Living Artist*, BLOOMBERG (Nov. 12, 2013), http://www.bloomberg.com/news/articles/2013-11-13/koons-s-puppy-sets-58-million-record-for-living-artist.

85. It is important to distinguish between knowledge goods that are primarily enjoyed in a single country (e.g., cranberry-related research) and the "local public goods" of Tieboutian theory. *See* Charles M. Tiebout, *A Pure Theory of Local Expenditures*, 64 J. POL. ECON. 416, 418 (1956) (mentioning beaches, parks, municipal golf courses, police protection, roads, and parking facilities as examples of local public goods). Residents of other nations are in no way excluded (by law or by distance) from enjoying the benefits of local knowledge goods. What makes a knowledge good "local" is that demand is geographically concentrated.

86. *See* TODD SANDLER, GLOBAL COLLECTIVE ACTION 89 (2004). For example, R&D on neglected diseases that primarily affect populations with low purchasing power is less likely to be funded than R&D on diseases that also

are localized, the government of a single country (or a small set of countries) will likely have an incentive to invest in R&D at or near the socially optimal level. If demand is dispersed, the marginal benefit of R&D investment for any one country is only a fraction of the marginal global benefit, and the free-rider problem is more severe.

2. Local Production Externalities

Even where demand for information is dispersed, the problem of producing global knowledge goods may be mitigated by the presence of positive local production externalities. Local production externalities arise when a nearby third party is affected (positively or negatively) by the production of a good or service and when the third party neither charges nor pays the producer commensurately. For example, a slaughterhouse might impose a negative production externality on its neighbors, while a bakery might impose a positive local production externality (the smell of fresh bread).[87]

Knowledge generation may result in positive local production externalities as well.[88] California's Silicon Valley serves as an illustration. Early firms in the area attracted workers with skills relevant to the semiconductor industry, providing a pool of potential employees with industry-specific knowledge for future ventures.[89] The early firms also attracted investors to Silicon Valley, leading to the growth of the venture capital sector.[90] These factors meant that by the late 1960s, the cost of producing semiconductor-related knowledge goods was lower in Silicon Valley than elsewhere. Thus, the cost to Intel of developing

affect the wealthiest countries, even when the neglected diseases have a higher human cost.

87. *See, e.g.*, Nicolas Guéguen, *The Sweet Smell of . . . Implicit Helping: Effects of Pleasant Ambient Fragrance on Spontaneous Help in Shopping Malls*, 152 J. SOC. PSYCHOL. 397 (2012) (finding correlation between pleasant smells and altruism).

88. For an argument that sub-national governments can internalize many of the benefits of their public spending on innovation, see Camilla Alexandra Hrdy, *Patent Nationally, Innovate Locally*, 31 BERKELEY TECH. L.J. (forthcoming 2016), http://ssrn.com/abstract=2670400.

89. *See* David P. Angel, *High-Technology Agglomeration and the Labor Market: The Case of Silicon Valley*, *in* UNDERSTANDING SILICON VALLEY: THE ANATOMY OF AN ENTREPRENEURIAL REGION 124, 130 (Martin Kenney ed., 2000).

90. *See* Martin Kenney & Richard Florida, *Venture Capital in Silicon Valley: Fueling New Firm Formation*, *in* UNDERSTANDING SILICON VALLEY, *supra* note 89, at 98, 107–09.

a four-bit central processing unit circa 1971 was likely lower in northern California than it would have been in, say, North Dakota; Intel had access to skilled workers who had acquired industry-specific knowledge at other firms, as well as access to potential sources of capital. In this way, efforts by the early firms in Silicon Valley (e.g., Hewlett-Packard and Fairchild Semiconductor) yielded positive local production externalities from which subsequent entrants (e.g., Intel and Apple) benefitted.[91]

Putting this into the public-goods framework, one might say that semiconductor-related research in Silicon Valley in the 1960s yielded benefits with different degrees of globalness. The microprocessor is certainly not a cranberry-type good: demand is widely dispersed.[92] On the other hand, the positive production externalities of semiconductor-related research were geographically concentrated: firms in Silicon Valley could benefit from improved access to skilled labor, knowhow, and capital in ways that firms in Switzerland could not. In other words, Silicon Valley firms had geographically sticky complementary assets that made investments in knowledge about, say, new semiconductor architectures far more valuable in that geographically concentrated region than outside it, regardless of whether the knowledge was free for other regions to copy.

The story of Silicon Valley is (largely)[93] a story of positive local production externalities generated by private activity, but public R&D spending can likewise lead to positive local production externalities.[94] Consider the case of Huntsville, Alabama,

91. On positive local production externalities, see generally Paul Krugman, *Increasing Returns and Economic Geography*, 99 J. POL. ECON. 483 (1991).

92. This was not always the case. In the 1970s, Tim Berners-Lee tried to sell circuit boards with early microprocessors in Oxford (before later going on to invent the World Wide Web), but he was not as successful as Steve Jobs and Steve Wozniak were with a similar endeavor in Silicon Valley partly because Oxford did not have the demand supplied by Silicon Valley computer hobbyist groups. WALTER ISAACSON, THE INNOVATORS 407 (2014). Other knowledge goods may similarly shift from cranberry-type goods to more global public goods over time.

93. While most accounts of Silicon Valley's success have focused on individual entrepreneurs, public funds also played a key role. *See* NAT'L RESEARCH COUNCIL, FUNDING A REVOLUTION: GOVERNMENT SUPPORT FOR COMPUTING RESEARCH (1999) (discussing the role of government funding in the computer revolution); Stuart W. Leslie, *The Biggest "Angel" of Them All: The Military and the Making of Silicon Valley*, *in* UNDERSTANDING SILICON VALLEY, *supra* note 89, at 48, 50.

94. *See, e.g.*, Gil Avnimelech & Morris Teubal, *The Emergence of Israel's*

home to NASA's Marshall Space Flight Center since 1960. The NASA center has attracted thousands of physicists, engineers, and other highly skilled workers to Huntsville; by one measure, Huntsville ranks second in the nation in the number of high-tech workers per capita (behind only Silicon Valley).[95] Several former NASA employees have gone on to found startups of their own; these new ventures benefit from access to Huntsville's highly skilled labor pool and close connections with basic researchers at NASA.[96] Larger companies that value proximity to U.S. military and NASA facilities (including Boeing, Northrop Grumman, and Lockheed Martin) have established substantial presences in the Huntsville area as well.[97] Some of the knowledge generated by research at the Marshall Space Flight Center meets the definition of a global public good: the Hubble Space Telescope is perhaps the most prominent example of a project pursued at Marshall that has yielded benefits for researchers worldwide. At the same time, many of the economic benefits of R&D spending at Marshall are concentrated in the surrounding area.[98]

Some argue that the incentive to attract mobile capital may lead jurisdictions to invest in knowledge goods at levels *above* the social optimum. For instance, Israel may lure Intel to set up a new facility south of Tel Aviv by offering tax incen-

Venture Capital Industry: How Policy Can Influence High-Tech Cluster Dynamics, *in* CLUSTER GENESIS: TECHNOLOGY-BASED INDUSTRIAL DEVELOPMENT 172 (Pontus Braunerhjelm & Maryann Feldman eds., 2006); Martha Prevezer & Han Tang, *Policy-Induced Clusters: The Genesis of Biotechnology Clustering on the East Coast of China*, *in* CLUSTER GENESIS, *supra*, at 113.

95. *See* TECHAMERICA FOUND., CYBERCITIES 2010: THE DEFINITIVE ANALYSIS OF THE HIGH-TECHNOLOGY INDUSTRY IN THE NATION'S TOP 60 CITIES 8 (2010).

96. *See, e.g.*, NASA, NASA'S IMPACT IN ALABAMA: A TECH TRANSFER PERSPECTIVE (2012), https://www.nasa.gov/externalflash/economic-impacts/Alabama_NASA-Economic-Impacts.pdf.

97. *See Leading Employers Huntsville/Madison County*, CHAMBER OF COMMERCE OF HUNTSVILLE/MADISON CNTY., http://www.huntsvillealabamausa.com/index.php?option=com_content&view=article&id=194&Itemid=355 (last updated June 2016).

98. Similarly, public investments in technology infrastructure—such as the U.S. broadband sales tax exemption or direct funding of the U.S. National Nanotechnology Infrastructure Network—provide benefits to local industry that are difficult for other jurisdictions to appropriate. *See* Hemel & Ouellette, *supra* note 3, at 332 & n.140; Lisa Larrimore Ouellette, *Nanotechnology and Innovation Policy*, 29 HARV. J.L. & TECH. 33, 69 (2015). These kinds of infrastructure investments lower the costs of knowledge production for firms located close enough to use them, which draws technology producers to the area.

tives,[99] but little is gained from a global welfare perspective if the new facility in Israel simply replaces one in California. Indeed, studies of U.S. states provide some evidence of a "beggar-thy-neighbor" effect from state tax incentives for R&D.[100] Theoretical work similarly suggests that international competition may lead to supraoptimal subsidies for R&D under certain circumstances.[101]

We are agnostic as to whether this story of overinvestment due to local production externalities is a plausible one. To see why it might not be, consider again the example of bakeries that generate a positive local production externality—the smell of fresh bread. We can imagine residents banding together to subsidize bakeries in their neighborhood, and we can imagine bakeries moving from one neighborhood to another in order to capture such subsidies. But would this lead to too much production of bread? It is not obvious why subsidies would lead to overproduction. No resident group would have an incentive to offer a subsidy larger than the local production externality (i.e., the benefit that the bakery brings to the neighborhood). Resident groups that place a higher value on the smell of bread might bid to lure bakeries to their neighborhoods, but this would likely lead to an even more efficient geographic distribution of bakeries—with bread being baked in the areas that appreciate it most.

To be sure, one can construct a model in which subsidies are supraoptimal. Let's say that the supply of bread is inelastic; thus, the subsidy from residents to bakeries is a pure transfer, with no effect on output. But if the subsidy is financed through a mechanism (such as a tax) that itself yields deadweight loss, then the subsidy is in that sense supraoptimal: something is lost and nothing is gained. Why, though, would we expect the supply of bread (or of knowledge goods) to be inelastic? And even if supply is inelastic, subsidies may have efficiency-enhancing effects: they may spur bakeries (or analogously,

99. *See, e.g.*, David Shamah, *How Intel Came To Be Israel's Best Tech Friend*, TIMES OF ISRAEL (Apr. 23, 2015), http://www.timesofisrael.com/how-intel-came-to-be-israels-best-tech-friend.

100. *See, e.g.*, Daniel J. Wilson, *Beggar Thy Neighbor? The In-State, Out-of-State, and Aggregate Effects of R&D Tax Credits*, 91 REV. ECON. & STAT. 431 (2009).

101. *See* Barbara J. Spencer & James A. Brander, *International R&D Rivalry and Industrial Strategy*, 50 REV. ECON. STUD. 707 (1983) (discussing the importance of R&D subsidies to domestic welfare).

knowledge producers) to relocate to the areas in which the local production externalities from their activities are highest.

Our argument, then, is not a claim about overinvestment. Rather, our argument is that in a price-taking (non-strategic)[102] model, rational and self-interested states will invest in knowledge production up to the point that the marginal benefits from a national-welfare perspective equal the marginal costs, and that the left side of the equation includes both the benefits that citizens of the state derive from the consumption of knowledge goods as well as positive local production externalities. The larger these terms are relative to the marginal global benefits, the less underinvestment we should expect to see. In sum, when knowledge goods are more local than global—i.e., when consumption is concentrated geographically and production generates positive externalities that depreciate across space—then the underinvestment problem described above is less of a problem.

3. An Extension of the Formal Economic Model

To illustrate how this richer understanding of knowledge goods affects the underinvestment hypothesis, we continue with the rudimentary formal model begun in Part I. As before, x is the level of investment in the production of a particular knowledge good; $B_A(x)$ is the benefit to consumers in S_A from investment of x in the relevant good; B_{global} is the sum of all Bs for all nation-states; and $C(x)$ is the cost of investing x. Also, as before, the globally optimal level of investment is x_{global}*; and x_A* < x_{global}* when $B_A(x) < B_{global}(x)$.

The presence of positive local production externalities further complicates this story. Let $PE(x)$ represent the production externality from x level of investment. Assume that the production externality is captured entirely by the country that makes the investment. For instance, diabetes research might benefit all diabetes patients, but diabetes research in Israel might confer an additional advantage on Israeli biotech firms who benefit from access to the talent pool of diabetes researchers attracted to Israel as a result of the investment. Once positive local production externalities enter the picture, the solution to S_A's optimization problem changes. Now, S_A sets x_A* such that $B_A'(x_A$*)

102. Strategic interactions complicated this model: states may try to commit to underinvestment so as to induce other states to invest more. *See infra* notes 226–30 and accompanying text.

$+ PE'(x_A^*) = C'(x_A^*)$. As long as $PE'(x) > 0$, the addition of this term pushes x_A^* upward.

This formalization allows us to make more precise claims about underinvestment. First, underinvestment becomes less severe as $B_A(x)/B_{global}(x)$ approaches 1, meaning that the knowledge good is closer to a local public good than a global one. (When $B_A(x)/B_{global}(x) = 1$, the good is a pure cranberry good and the underinvestment problem goes away.) Second, underinvestment becomes less severe when $PE'(x)$ is large relative to other terms in S_A's calculus. Another way to say this is that presence of positive local production externalities makes investment in the provision of knowledge goods more attractive from a national perspective. The underinvestment hypothesis appears most plausible when knowledge goods are global public goods and states are rational actors seeking to maximize absolute gains. As we discuss below, however, the underinvestment hypothesis does not get us the whole way to a justification for the international IP regime, because IP is not the only way for consumer nation-states to compensate producer states. We pick up the question of institutional design in Part IV and discuss alternative institutional structures that might support cooperative outcomes. Before that, though, we interrogate the assumption that states are rational actors whose motive is to maximize the welfare of their own citizens.

B. WHAT MOTIVATES NATION-STATES?

Our predictions so far have been based on the assumption that states are rational actors that seek to maximize the absolute welfare of their citizens. In the international relations literature, this assumption is associated with the theory of institutionalism (also known as "regime theory").[103] According to institutionalism, states are "rational egoists" that (at least sometimes) see each other as potential partners in mutually beneficial cooperative endeavors.[104] Institutions such as inter-

103. *See* Joseph M. Grieco, *Anarchy and the Limits of Cooperation: A Realist Critique of the Newest Liberal Institutionalism*, 42 INT'L ORG. 485, 494 tbl.1 (1988); Arthur A. Stein, *Coordination and Collaboration: Regimes in an Anarchic World*, 36 INT'L ORG. 299, 318 (1982) (noting that regime theory sees states as "actors [who] focus on their own returns and compare different outcomes with an eye to maximizing their own gains" as distinguished from the "alternative conception" of states as "actors [who] seek to maximize the difference between their own returns and those of others").

104. Robert O. Keohane & Lisa L. Martin, *The Promise of Institutionalist Theory*, 20 INT'L SECURITY 39, 39 (1995).

national agreements and organizations play a key role in this story.[105] For institutionalists, the challenge of global public good production is largely a problem of institutional design, and arrangements with incentive-compatible features can yield cooperative outcomes.[106]

The institutionalist perspective thus maps nicely onto the economic account presented thus far of IP treaties as solving the uncompensated-externalities underinvestment problem. But the international political economy literature has presented other accounts of how nation-states are motivated. In this Section, we examine three leading alternative accounts—grounded in national security concerns, international norms, and domestic politics—and their implications for investment in knowledge goods.

1. National Security

Until recently, the "dominant theory" of international relations was not institutionalism—it was realism,[107] which "paints a rather grim picture of world politics."[108] Like institutionalists, realists assume that nation-states are rational actors, but realists believe that states are focused on relative rather than absolute gains.[109] This is because "[s]tates are potentially dangerous to each other," are unsure of each other's intentions, and want—more than anything else—to maintain their own sovereignty.[110]

Based on these assumptions, realists predict that states will "aim to maximize their relative power position over other states"—or, at the very least, to "maintain[] the existing bal-

105. *See* ROBERT O. KEOHANE, AFTER HEGEMONY: COOPERATION AND DISCORD IN THE WORLD POLITICAL ECONOMY 244 (1984).

106. *See* Barbara Koremenos et al., *The Rational Design of International Institutions*, 55 INT'L ORG. 761, 766–68 (2001).

107. *See* MICHAEL W. DOYLE, WAYS OF WAR AND PEACE 41 (1997); *see also* Thomas C. Walker & Jeffrey S. Morton, *Re-Assessing the "Power of Power Politics" Thesis: Is Realism Still Dominant?*, 7 INT'L STUD. REV. 341 (2005) (documenting decline in proportion of articles in international relations journals adopting a realist perspective).

108. John J. Mearsheimer, *The False Promise of International Institutions*, 19 INT'L SECURITY 5, 9 (1994).

109. *Id.* at 12.

110. *Id.* at 10. More precisely, realists break these beliefs into five assumptions about the international system. *Id.* Different scholars frame these assumptions slightly differently, *e.g.*, Grieco, *supra* note 103, at 488, but these differences are not significant here.

ance of power."[111] In measuring "power," realists look not only to a state's military strength, but also to its supply of scientific and technological talent.[112] Thus, realists predict that states will invest in science education and research in order to maintain power parity with (or gain a relative advantage over) potential rivals.[113]

The "Space Race" between the United States and Soviet Union in the second half of the twentieth century is—at least arguably[114]—an illustration of realist predictions proving to be correct. The successful launch of the first artificial satellite, Sputnik, by the Soviet Union in 1957 (combined with the initial failures of the United States' Vanguard satellite program)[115] shattered the American public's post-World War II sense of security.[116] The same rockets that put a satellite in orbit could, hypothetically, carry a nuclear warhead onto American soil. Perhaps more frighteningly, Sputnik seemed to be the tangible confirmation of reports from the mid-1950s that the Soviet Union was producing two to three times the number of scientists and engineers as the United States.[117] The national security

111. Mearsheimer, *supra* note 108, at 11 & n.27; *see also* Grieco, *supra* note 103, at 498 ("[R]ealists find that . . . *the fundamental goal of states in any relationship is to prevent others from achieving advances in their relative capabilities*.").

112. *See, e.g.*, ROBERT GILPIN, FRANCE IN THE AGE OF THE SCIENTIFIC STATE 15 (1968) ("[S]cientific research has become a primary determinant of national power . . . ."); JOHN J. MEARSHEIMER, THE TRAGEDY OF GREAT POWER POLITICS 56 (2001) (noting that scientific achievements are an indicator of "latent capabilities" that a state can convert into military power).

113. *See, e.g.*, GILPIN, *supra* note 112 ("[T]he three goals of French foreign policy [in the 1960s]—the continued military deterrence of the Soviet Union, the economic and political containment of the United States, and the establishment of French primacy in western Europe—are greatly dependent on the state of French science and technology. For this reason . . . the advancement of scientific research has become a dominant concern of the leadership of contemporary France."); Harvey M. Sapolsky, *Science, Technology and Military Policy*, *in* SCIENCE, TECHNOLOGY AND SOCIETY: A CROSS-DISCIPLINARY PERSPECTIVE 443, 445 (Ina Spiegel-Rösing et al. eds., 1977) ("Governments have long acted as patrons of science in the hope of gaining improvements in the instruments and techniques of war; what is new in our time is the scale of the patronage offered and the impact which science has had on warfare.").

114. *But see* Rodger A. Payne, *Public Opinion and Foreign Threats: Eisenhower's Response to Sputnik*, 21 ARMED FORCES & SOC'Y 89 (1994) (questioning the realist account).

115. *See* Roger Launius, *Sputnik and the Origins of the Space Age*, NASA, http://history.nasa.gov/sputnik/ (last visited Oct. 13, 2016).

116. *See* PAUL DICKSON, SPUTNIK: THE SHOCK OF THE CENTURY 4 (2001).

117. *See* David Kaiser, *The Physics of Spin: Sputnik Politics and American Physicists in the 1950s*, 73 SOC. RES. 1225, 1227 (2006).

implications of this technological gap prompted the United States to quickly make scientific education and space-related technologies national priorities. Within two years of Sputnik's launch, Congress increased funding for the National Science Foundation from $40 million to $140 million,[118] created NASA to coordinate and fund the space program,[119] and launched the Advanced Research Projects Agency (now DARPA) within the Department of Defense.[120] After years of reluctance to provide federal assistance to education, Congress passed the National Defense Education Act in 1958 to increase the number of students in science at advanced levels.[121] Maintaining an edge in scientific talent began to be seen as essential to the long-term security of the United States.[122] And those national security concerns catalyzed public spending on R&D, setting the stage for countless future scientific advances (not the least of which was "ARPANET," the technological foundation of today's Internet).[123]

The realist perspective on public R&D spending starkly contrasts with the free-rider narrative. If the free-rider account is correct, then we would expect Country A's spending on R&D to *decrease* as Country B's R&D spending increases (i.e., Coun-

118. *National Science Foundation Budget*, 127 SCIENCE 510 (1958).

119. *See* Launius, *supra* note 115.

120. *See* Duncan Graham-Rowe, *Fifty Years of DARPA: A Surprising History*, NEW SCIENTIST (May 15, 2008), https://www.newscientist.com/article/dn13908-fifty-years-of-darpa-a-surprising-history.

121. *See* BARBARA BARKSDALE CLOWSE, BRAINPOWER FOR THE COLD WAR: THE SPUTNIK CRISIS AND THE NATIONAL DEFENSE EDUCATION ACT OF 1958 at 4 (1981).

122. *See* Donald A. Quarles, *Cultivating Our Science Talent—Key to Long-Term Security*, 80 SCI. MONTHLY 352 (1955); *see also* ISAACSON, *supra* note 92, at 72 ("War mobilizes science . . . and this was especially true in the mid-twentieth century. Many of the paramount technological feats of that era—computers, atomic power, radar, and the Internet—were spawned by the military.").

123. *See* Sharon Weinberger, *Still in the Lead?*, 451 NATURE 390 (2008). The expressed desire to maintain comparative technological superiority did not die with the fall of the Soviet Union. For example, news that China is poised to surpass the United States in research and development spending by 2022 was greeted not with joy that there will be more knowledge production for us to free-ride on, but with concern about the need to preserve "American superiority." Jacqueline Klimas, *Lawmakers Worry China Will Top U.S. in Scientific Research*, WASH. TIMES (Mar. 27, 2014), http://www.washingtontimes.com/news/2014/mar/27/lawmakers-worry-china-will-top-us-scientific-resea. One congressman was quoted as saying, "I wish we could be investing even more, especially as other nations are rising to challenge our pre-eminence." *Id.* (quoting Representative Adam B. Schiff).

try A would stand aside as Country B plows ahead). The realist perspective yields quite a different prediction: insofar as Country A and Country B are potential military rivals, Country A's spending on R&D will *increase* with Country B's. Rather than free-riding off Country A's expenditures, Country B will bolster its R&D efforts in an attempt to keep pace. Moreover, while the free-rider narrative predicts that aggregate public spending on R&D will fall below the global social optimum, realism suggests the possibility of the opposite result. One country's efforts to boost its own scientific and technological capabilities—and thus its security—may decrease the security of others.[124] In this way, a lack of coordination among countries with respect to R&D spending may result in each country investing *more* than the globally optimal amount in certain areas of science and technology.

One might question whether the realist account has any explanatory power beyond the limited domain of defense and defense-related technology. Moreover, while the realist account might suggest the possibility of overinvestment (at least in some areas), it might also lead us to expect to see "undersharing" (i.e., states focused on relative gains will keep their scientific and technological advances secret from potential rivals).[125] In practice, though, even research for which the primary results are not shared can lead to significant spillovers.[126] Furthermore, we observe defense research agencies investigating a wide array of topics and publicizing their results on subjects ranging from concussion prevention[127] to climate change[128]

124. Robert Jervis, *Cooperation Under the Security Dilemma*, 30 WORLD POL. 167, 170 (1978).

125. For example, U.S. patents can be kept secret when the government determines that publication would be a national security threat. 35 U.S.C. § 181 (2012); *see, e.g.*, G.W. Schulz, *Government Secrecy Orders on Patents Have Stifled More than 5,000 Inventions*, WIRED (Apr. 16, 2013), https://www.wired.com/2013/04/gov-secrecy-orders-on-patents.

126. For example, the space race led to developments ranging from satellite television to carbon monoxide detectors. Rob Mead, *10 Tech Breakthroughs To Thank the Space Race for*, TECHRADAR (July 20, 2009), http://www.techradar.com/us/news/world-of-tech/10-tech-breakthroughs-to-thank-the-space-race-for-617847.

127. Kris Osborn, *NFL-Army Collaborative Research on Concussions Yields Initial Results*, SCOUT (Nov. 20, 2015), http://www.scout.com/military/warrior/story/1613090-army-nfl-test-high-tech-helmets-for-safety.

128. Kris Osborn, *Navy Researchers Are Analyzing Findings from Drones Beneath Arctic Ice*, SCOUT (Nov. 30, 2015), http://www.scout.com/military/warrior/story/1618090-navy-drones-patrol-beneath-arctic-ice.

to the treatment of infectious diseases.[129] To be sure, some of this research may be driven by motives unrelated to national security; the fact that it is carried out by a defense research agency could be bureaucratic happenstance. However, we think that a realist approach might offer some relevant insights.

For some scholars in the realist tradition, the perception of power is as important as power itself.[130] Capabilities are useful to states in international politics not only because they can be deployed in wartime, but because they can be used to deter or influence other states in peacetime. A state that amasses scientific and technological capabilities may want to send signals to other states clueing them into that fact. Yet for reasons that are obvious, the United States might not want to invite a cadre of Russian Air Force generals to inspect its latest fighter jet. Instead, the United States wants Russia to know that the United States has the capability to develop cutting-edge weaponry but does not want to share too many details of its technology with a potential rival.

One way to accomplish this objective is for the United States to publicize the results of research showing that its scientists are top-rate. Ideally, the research would be relevant enough to defense applications that it would lead Russia to raise its estimate of U.S. military capabilities—but not so closely related to defense applications that publicizing the results would amount to giving away the store. The research need not be conducted by the U.S. military itself as long as the results lead Russia to elevate its estimate of the quality of scientists that the U.S. military might have at its disposal. Of course, if the research product also yields benefits for U.S. consumers, then all the better. But the selection of research projects for signaling purposes does not necessarily follow the marginal cost/marginal benefit calculus discussed above.

We cannot say *how much* government-sponsored research is explained by our signaling story; we offer the signaling theory simply as a reason *why* security-focused states might invest in science and technology. The signaling account is probably

129. *See, e.g.*, DEFENCE SCI. & TECH. LAB., LICENSING OPPORTUNITY: GAMMA-GLUTAMYL TRANSPEPTIDASE ATTENUATED FRANCISELLA (2015), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/399418/Gamma-glutamyl_transpeptidase_attenuated_Francisella_Easy_Access_IP_factsheet.pdf.

130. *See* William C. Wohlforth, *The Perception of Power: Russia in the Pre-1914 Balance*, 39 WORLD POL. 353, 353–54 (1987).

most plausible with respect to military powers (e.g., the United States and Russia) that are keenly concerned about the way that other states perceive their capabilities; it is a less plausible explanation for public R&D spending in, say, Switzerland.[131] For present purposes, our point is only that some nation-states may finance the production of knowledge goods even in circumstances where the conventional account might suggest that they would not (i.e., where the marginal benefit to domestic consumers is less than the marginal cost).

2. Norms

A more recent rival to realism and institutionalism is "constructivism."[132] Unlike realists and institutionalists, who start from fixed assumptions about state interests, constructivists seek to "open[] up . . . the black box of interest and identity formation"; their central claim is that state interests emerge from their interactions with other states and international institutions.[133] The difference between realists and institutionalists, on the one side, and constructivists, on the other, is sometimes described as the difference between a "logic of consequences" and a "logic of appropriateness."[134] Whereas realists and institutionalists assume that states act strategically in order to achieve their individual goals, constructivists argue that interstate interactions help to determine what goals each state pursues.[135] Phrased differently, constructivists believe that

131. Note, though, that Japan—whose constitution outlaws war as a means of settling interstate disputes—may gain substantial security benefits from the perception that its scientists could, if pressed, develop offensive nuclear capabilities very quickly. *Cf.* Jeffrey Lewis, *If Japan Wanted to Build a Nuclear Bomb It'd Be Awesome at It*, FOREIGN POL'Y (June 26, 2014), http://www.foreignpolicy.com/2014/06/26/if-japan-wanted-to-build-a-nuclear-bomb-itd-be-awesome-at-it (discussing Japan's potential nuclear capabilities).

132. *See* Jeffrey T. Checkel, *The Constructivist Turn in International Relations Theory*, 50 WORLD POL. 324, 324–25 (1998); John Gerard Ruggie, *What Makes the World Hang Together? Neo-Utilitarianism and the Social Constructivist Challenge*, 52 INT'L ORG. 855, 856 (1998).

133. Checkel, *supra* note 132, at 326.

134. *See, e.g.*, James G. March & Johan P. Olsen, *The Institutional Dynamics of International Political Orders*, 52 INT'L ORG. 943, 949–52 (1998).

135. *See, e.g.*, *id.* at 949; *see also* Jack Goldsmith, *Sovereignty, International Relations Theory, and International Law*, 52 STAN. L. REV. 959, 965 (2000) (reviewing STEPHEN D. KRASNER, SOVEREIGNTY: ORGANIZED HYPOCRISY (1999)) ("[Constructivists] argue that international norms help constitute the identity of actors on the international stage (such as nations and rulers) and help shape their interests. In this way, national behaviors are significantly influenced by international norms in ways that do not reduce to an instrumen-

states, "through their social interaction in accordance with the characteristic rules and processes of [the international] system, learn from and confirm to each other *what it means to be a state*."[136] And as states update their understanding of what the international system expects from them, they conform their behavior to the prevailing logic of appropriateness.

All of this might sound highly abstract, but a concrete example may help to illustrate. Martha Finnemore observes that through the mid-1960s, "poverty alleviation" was not "an explicitly articulated and internationalized goal of states and multilateral governmental agencies"; rather, development efforts by states and international organizations focused primarily on *growth*.[137] Finnemore further argues that the World Bank, under the leadership of Robert McNamara, played a pivotal role in convincing states in the late 1960s and 1970s to redirect their development efforts from the goal of growth to the goal of poverty alleviation.[138] That is, McNamara and the World Bank triggered a "normative shift" resulting in a widespread belief that poverty alleviation was something "that states were supposed to do."[139] McNamara and the World Bank succeeded in altering the logic of appropriateness, such that states now believe that the international community expects them to make poverty reduction a policy priority.[140] Constructivist scholars have pointed to other "normative shifts"—on matters ranging from slavery to the killing of whales and elephants—that appear to be the result of similar dynamics.[141]

Just as realism directs our attention to security concerns and institutionalism directs our attention to the design features of international organizations and agreements, constructivism directs our attention to the norms that guide state behavior. On the constructivist view, states will invest in knowledge production if they come to perceive science as *something states are supposed to do*. Similarly, a state's choice between IP and non-IP mechanisms will depend not only on the

tal calculus.").

136. David Armstrong, *Globalization and the Social State*, 24 REV. INT'L STUD. 461, 468 (1998) (emphasis added).

137. MARTHA FINNEMORE, NATIONAL INTERESTS IN INTERNATIONAL SOCIETY 96–97 (1996).

138. *Id.* at 103–27.

139. *Id.* at 90.

140. *Id.* at 125.

141. Ethan A. Nadelmann, *Global Prohibition Regimes: The Evolution of Norms in International Society*, 44 INT'L ORG. 479 (1990).

perceived costs and benefits of those tools, but also on the perceived appropriateness of each approach.

Constructivism helps to explain the widespread creation of science policy organizations by developing countries in the third quarter of the twentieth century. Starting in the 1950s, officials of the United Nations Educational, Scientific and Cultural Organization (UNESCO) began to encourage member states to set up their own science bureaucracies and to invest in R&D domestically.[142] A UN report at the dawn of the next decade declared that "[s]tates should make it their business" to promote scientific research within their own borders.[143] In 1967, a UNESCO statement of principles proclaimed that "[t]he development of science policy should be the responsibility of an organization at the highest level of government" in each country.[144] These and similar statements reflected an emerging international norm: scientific research, according to UNESCO officials, was something states ought to do, even if a rational-choice calculus would suggest that free-riding was the optimal strategy.

Martha Finnemore has shown how an emerging logic of appropriateness led small developing countries—including Lebanon, Ethiopia, Kenya, Sudan, Tanzania, and Zambia—to establish national science organizations by the end of the 1960s, with a view to promoting domestic R&D.[145] These efforts are difficult to explain from the perspective of rational institutionalism. As Finnemore notes, these nations may have been materially better off if they had followed a free-riding strategy.[146] Realism is no more helpful; there is no apparent reason to believe that developing countries achieved any security benefits as a result of their R&D investments. Finnemore's case studies suggest that at least some public R&D spending is best understood as a reflection of prevailing international norms, not as a consequence of economic or security considerations.[147]

142. Martha Finnemore, *International Organizations as Teachers of Norms: The United Nations Educational, Scientific, and Cutural Organization and Science Policy*, 47 INT'L ORG. 565, 576 (1993).

143. PIERRE AUGER, UNESCO, CURRENT TRENDS IN SCIENTIFIC RESEARCH 220 (1961).

144. UNESCO, *Principles and Problems of National Science Policy*, *in* 5 SCI. POL'Y STUD. & DOCUMENTS SERIES 87, 87 (1967).

145. Finnemore, *supra* note 142, at 587–91.

146. *Id.* at 583.

147. *Id.* at 592.

This norms-based account might be reframed as a prestige-based account: investments in the production of knowledge goods (and, in particular, investments that yield successful results) raise a nation-state's standing in the international community. The pursuit of prestige—like the quest for security in the realist account—may be a zero-sum game: if prestige is relative, then one nation-state's investment in increasing its own prestige may decrease the utility of other states.[148] Alternatively, prestige may serve as a substitute for cash transfers from consumer nation-states to producer nation-states. For example, if the U.S. National Institutes for Health (NIH) develops a successful Ebola vaccine and gives it away to patients in West African countries at zero cost, the United States may be partially compensated for its efforts through prestige gains.[149] A full-fledged prestige-based account would require a more careful specification of the particular benefits that prestige brings as well as the reasons why nation-states pursue those benefits. While we do not develop such an account here, we note the possibility that elements of the constructivist account may be translatable into a rational-actor model in which $T_{B \to A}$ (the transfer from the consumer state to the producer state) takes a nonmonetary form.

To be sure, nothing in constructivist theory suggests that international norms will always lead countries to invest *more* in R&D. Norms can push nations in the opposite direction—for example, leading states not to invest in research related to genetically modified organisms (GMOs).[150] The key point is that constructivist theory, like realism, may aid in explaining why patterns of public R&D spending diverge from the free-rider account's predictions. Constructivism cannot, however, tell us the direction or magnitude of that divergence in all cases.

148. *See* Duncan Snidal, *Relative Gains and the Pattern of International Cooperation*, 85 AM. POL. SCI. REV. 701, 704 (1991).

149. For a discussion of NIH efforts to find an Ebola vaccine, see Thomas M. Burton, *NIH Expands Testing of Ebola Drugs and Vaccines into New Countries*, WALL ST. J. (June 23, 2015), http://www.wsj.com/articles/nih-expands-ebola-research-into-new-countries-in-search-for-vaccine-1435093932.

150. *See* Robert Falkner, *The Political Economy of 'Normative Power' Europe: EU Environmental Leadership in International Biotechnology Regulation*, 14 J. EUR. PUB. POL'Y 507 (2007) (discussing the spread of Europe's more-restrictive GMO regulatory regime through European "normative" leadership).

3. Domestic Politics

A fourth perspective, known in the international relations literature as "liberalism" or "liberal intergovernmentalism," shares key features of the other three approaches but focuses attention on actors "above and *below* the nation-state."[151] Like realism and institutionalism, liberalism sees behavior on the international stage as the product of instrumentally rational action.[152] And like constructivism, liberalism opens up the "black box" of state interests. A foundational assumption of liberal international relations theory is that "[t]he fundamental actors in international politics are individuals and private groups, who are on the average rational" and who use state institutions to pursue their goals.[153] On this view, state action reflects the preferences of a subset of domestic society that has prevailed in political competition.[154] Liberals do not deny that the balance of power and the configuration of international institutions affect outcomes, but they posit that these variables have only a secondary influence. Liberals argue that "what states want is the primary determinant of what they do"—and "what states want" is primarily a function of who has won out in domestic political competition.[155]

The liberal perspective thus focuses our attention on interest groups at the domestic level who compete to influence national policy. Liberalism predicts that states will invest in science if—and only if—the beneficiaries of such investment have sufficient pull among policymakers domestically. Similarly, the selection of IP vs. non-IP tools will reflect interest-group politics. That is, state investment in knowledge production may have little to do with relative power (realism), absolute gains (institutionalism), or prevailing norms (constructivism), but will have much to do with the prevailing political alignment inside the state.

An optimistic version of the liberal account might posit that, at least in democratic countries, leaders will be responsive to public opinion and that the public generally supports domestic R&D spending. In the United States, for instance, a Pew

151. *See generally* Andrew Moravcsik, *Taking Preferences Seriously: A Liberal Theory of International Politics*, 51 INT'L ORG. 513 (1997) (discussing liberalism as a theory of international politics).

152. *Id.* at 516–20.

153. *Id.* at 516–20 (emphasis omitted).

154. *Id.* at 518.

155. *Id.* at 521.

survey in 2013 found that even when faced with a possible budget sequester, seventy-seven percent of the public wanted to maintain or increase research funding, while only twenty percent favored cuts.[156] A poll the following year found that seventy-one percent of U.S. adults believed that government investment in basic scientific research would "pay off in the long run."[157] Surveys in the United Kingdom and Japan find similar support for government spending on scientific research.[158] Perhaps these poll numbers reflect the fact that voters are conducting their own cost-benefit calculus and concluding that investment in R&D is a welfare-improving use of public resources. But given how difficult it is for even the most highly skilled economist to calculate the optimal level of public investment in R&D, a more plausible conclusion is that most voters support science spending based on a rough guess that benefits exceed costs rather than a rigorous cost-benefit evaluation.

A more pessimistic version of the liberal account, influenced by public choice theory rather than a faith in democratic processes, might lead us to consider whether some share of public R&D spending reflects rent-seeking activities by beneficiaries of such expenditures. Indeed, the same public-goods logic underlying the free-rider narrative suggests that well-organized interest groups will successfully extract wealth transfers from the state. Protection of the public fisc is itself a public good, as all taxpayers stand to benefit from the prudent allocation of government resources. In the political struggle between concentrated subsidy-seeking industry groups on the one hand and diffuse taxpayers on the other, we anticipate that free-riding behavior will be more rampant on the latter side, tilting the competitive balance in favor of the former.[159] At least

156. *As Sequester Deadline Looms, Little Support for Cutting Most Programs*, PEW RESEARCH CTR. (Feb. 22, 2013), http://www.people-press.org/2013/02/22/as-sequester-deadline-looms-little-support-for-cutting-most-programs.

157. PEW RESEARCH CTR., AMERICANS, POLITICS AND SCIENCE ISSUES 76 (2015), http://www.pewinternet.org/files/2015/07/2015-07-01_science-and-politics_FINAL-1.pdf.

158. *See* 1 NAT'L SCI. BD., SCIENCE AND ENGINEERING INDICATORS 2002, at 7–15 (2002) (noting that agreement with the statement "[e]ven if it brings no immediate benefits, scientific research that advances the frontiers of knowledge is necessary and should be supported by the Federal Government" has "consistently been in the 80-percent range" in the United States, and was seventy-two percent in the United Kingdom in 2000 and eighty percent in Japan in 1995 (citations omitted)).

159. *See* George J. Stigler, *The Theory of Economic Regulation*, 2 BELL J. ECON. & MGMT. SCI. 3 (1971).

some amount of public support for R&D may be attributed to this imbalance.[160]

Not all rents will take the form of direct subsidies to interest groups. For example, IP protection may serve as an indirect way of transferring rents to producers of knowledge goods—with the aforementioned advantage that IP does not require politicians to raise taxes.[161] Many accounts of the political economy of copyright lawmaking seem to fit within this more pessimistic vision of liberalism, with industry rent-seekers leading to over-protection,[162] raising questions about the validity of the underinvestment hypothesis for many creative works.

Rent extraction through R&D support also may be a way of skirting international trade law limits on production subsidies.[163] For instance, instead of an outright subsidy to aircraft manufacturers (which might trigger WTO sanctions),[164] the U.S. federal government might sponsor research on jet propulsion with potential applications for U.S. companies. To be sure, the indirect subsidy might not have its intended effect if foreign aircraft manufacturers can make use of the research findings just as easily as U.S. manufacturers can. Yet if U.S. firms—due to their proximity to the scientists carrying on the research—are better able to operationalize the results, then government support for the project might function much like a production subsidy while differing in name.[165]

160. *See* Rebecca M. Kysar, *The Sun Also Rises: The Political Economy of Sunset Provisions in the Tax Code*, 40 GA. L. REV. 335, 363–64 (2006) (noting that the "principal recipients" of the research credit under 26 U.S.C. § 41 (2012) are "large U.S. manufacturing corporations" who are "more than willing to invest in lobbying activities and campaign donations to ensure continuance of this large tax savings").

161. *See supra* notes 47–48 and accompanying text.

162. *See, e.g.*, Pamela Samuelson, *Is Copyright Reform Possible?*, 126 HARV. L. REV. 740, 740 (2013) ("Complaints have been legion that copyright industry groups and corporate copyright owners have sought and too often obtained extremely strong and overly long copyright protections that interfere with downstream creative endeavors and legitimate consumer expectations.").

163. *See generally* Alan O. Sykes, *Subsidies and Countervailing Measures*, *in* 2 THE WORLD TRADE ORGANIZATION: LEGAL, ECONOMIC AND POLITICAL ANALYSIS 83 (P. Macrory, A. Appleton & M. Plummer eds., 2005) (discussing subsidy interaction with international trade laws).

164. *See, e.g.*, *EU Launches New Trade Dispute with US over Boeing Subsidies: WTO*, BUS. INSIDER (Dec. 19, 2014), http://www.businessinsider.com/afp-eu-launches-new-trade-dispute-with-us-over-boeing-subsidies-wto-2014-12.

165. Why might U.S. firms have an advantage in operationalizing the results? Presumably the results would be published in English, and the scientists might be willing to meet with counterparts from U.S. firms. Moreover,

As with constructivism, the liberal perspective does not necessarily lead us to reject the underinvestment hypothesis. Just as beneficiaries of public support for R&D may lobby intensively for increasing expenditures, other constituencies (e.g., deficit hawks and tax-cut advocates) may push politicians in the opposite direction. But the liberal perspective does suggest that the process of determining domestic R&D spending levels is more complicated than the standard stories of free-riding and uncompensated externalities suggest. Even where free-riding would appear to be the optimal strategy from a national welfare perspective, corporate and other interest groups may convince politicians to devote additional resources to domestic R&D. By the same token, even where the internalized benefits of R&D investment would appear to exceed the budgetary costs, domestic politics may stand in the way of spending hikes.

What does all this mean for the conventional economic account of international coordination as a solution to the underinvestment problem? The short answer is that we cannot be certain; the underinvestment hypothesis is empirically unverifiable but intuitively plausible, at least with respect to knowledge goods of the global-public-good variety. While we expect that nation-states will be influenced by a variety of factors not captured in our rudimentary economic model, we have no strong reason to believe that these other factors will systematically favor underinvestment or overinvestment. Another way to say this is that for knowledge goods of the global-public-good type, the underinvestment hypothesis may yield an accurate but noisy estimate of state behavior; while we expect that behavior will diverge from the hypothesis's predictions in countless cases, we have no strong reason to expect systematic divergence in one direction or the other.

III. DOMESTIC DIVERSITY UNDER INTERNATIONAL IP LAW

Under the "harmonization hypothesis" presented in Part I, agreements such as TRIPS dictate how nation-states subsidize and allocate knowledge goods at the domestic level, leading to "too much" IP and "too little" support for non-IP mechanisms. As we explain here, however, the existence of a global IP re-

U.S. firms might be able to hire the scientists themselves after the project is complete, making the transfer of knowledge from government to domestic industry even more seamless.

gime does not require any individual nation-state to rely on IP as a mechanism for incentivizing innovation or allocating access to knowledge goods at the domestic level. At first glance, this claim may seem surprising. After all, if a country signs a global IP treaty such as TRIPS, doesn't that obligate the country to provide protection for IP domestically? To a limited extent, the answer is yes: a TRIPS signatory must establish copyright and patent systems that meet minimum standards and treat citizens of other signatories at least as favorably as its own citizens.[166] Yet, as we explain in the following two sections, TRIPS still leaves individual nations substantial leeway to adopt alternative arrangements for both the provision and allocation of knowledge goods within their own borders.

A. THE SEPARABILITY OF INTERNATIONAL AND DOMESTIC INCENTIVES

International IP treaties require nation-states to offer minimum levels of IP protection for knowledge production, which ensures that foreign consumers bear some of the cost of domestic innovation through the higher prices they pay on IP-protected goods. This appears to create an asymmetry between IP and non-IP incentives, in that foreign consumers need not contribute to non-IP subsidies for knowledge production, even when they reap substantial benefits. But the existence of international IP treaties means that nation-states can in fact seek compensation from foreign consumers. That is, the international IP system allows states to internalize some of the benefits of knowledge produced through public finance mechanisms.

Most directly, recipients of knowledge-production subsidies such as prizes, grants, and tax credits could be required to assign all IP rights to the state, which could enforce those rights abroad. Thus, the fact that a country has signed onto a global IP treaty doesn't mean that the country must use IP to incentivize information production at the domestic level. Rather, a country that signs onto a global IP treaty *acquires the option* to seek compensation from foreign users of domestically produced knowledge goods, while retaining the freedom to choose whatever innovation-incentive mechanism it pleases at the domestic level.[167]

166. *Overview: The TRIPS Agreement*, WORLD TRADE ORG., https://www.wto.org/english/tratop_e/trips_e/intel2_e.htm (last visited Oct. 13, 2016).

167. Commentators advocating for opt-in medical prize schemes have noted

This possibility is not purely hypothetical. U.S. federal agencies that develop knowledge goods in-house often retain IP rights to their inventions and then license those inventions internationally (as well as domestically).[168] But a state need not assert foreign IP rights itself to obtain compensation from abroad; it could also allow the innovator to assert these rights and then collect a share of the profits through taxation. The U.S. federal government offers a tax credit equal to twenty percent of research expenses above a "base amount" (the base amount is calculated on the basis of the taxpayer's historical research expenditures),[169] but the federal government effectively reclaims a portion of the returns to R&D when it imposes a tax on corporate and individual income.

Recipients of federal research grants in the United States are also able to patent inventions resulting from that research under the Bayh-Dole Act and license them for domestic manufacture (a regime that has been replicated in many other countries).[170] Then, when foreign consumers purchase goods and

that these systems are clearly TRIPS compliant. HOLLIS & POGGE, *supra* note 61, at 106; *see also* WILLIAM W. FISHER III & TALHA SYED, INFECTION: THE HEALTH CRISIS IN THE DEVELOPING WORLD AND WHAT WE SHOULD DO ABOUT IT (forthcoming 2017) (manuscript ch. 5, at 37), http://cyber.law.harvard.edu/people/tfisher/Infection_Prizes.pdf. Opt-in prize systems need not be implemented on a global scale: an individual country can offer a prize for relinquishment of domestic IP rights while still enforcing IP rights abroad.

168. In 2014, the National Institutes of Health, Centers for Disease Control and Prevention, and Food and Drug Administration brought in over $137 million in patent royalties. NAT'L INSTS. OF HEALTH, OTT STATISTICS, http://www.ott.nih.gov/ott-statistics (last visited Oct. 13, 2016). The Departments of Energy and Defense are active patenters as well. PAUL W. HEISEY ET AL., U.S. DEP'T OF AGRIC. ECON. RESEARCH SERV., GOVERNMENT PATENTING AND TECHNOLOGY TRANSFER 16 (2006), http://www.ers.usda.gov/media/471043/err15_1_.pdf. The phenomenon is not limited to the United States: the governments of France, Japan, South Korea, Taiwan, China, and India have all amassed patent portfolios (including, in some cases, acquiring patent rights from abroad). HOSUK LEE-MAKIYAMA & PATRICK MESSERLIN, EUR. CTR. FOR INT'L POLITICAL ECON., SOVEREIGN PATENT FUNDS (SPFS): NEXT-GENERATION TRADE DEFENCE? 3–4 (2014), http://ecipe.org/app/uploads/2014/12/PB06.pdf.

169. 26 U.S.C. § 41 (2012).

170. *See* 35 U.S.C. §§ 200–211 (2012); David C. Mowery & Bhaven N. Sampat, *The Bayh-Dole Act of 1980 and University–Industry Technology Transfer: A Model for Other OECD Governments?*, *in* ESSAYS IN HONOR OF EDWIN MANSFIELD 233, 241 (Albert N. Link & F. M. Scherer eds., 2005); Anthony D. So et al., *Is Bayh-Dole Good for Developing Countries? Lessons from the US Experience*, 6 PLOS BIO. 2078 (2008) (suggesting safeguards to apply in developing countries). For examples of domestic-industry provisions in the equivalent of Bayh-Dole in other countries, see Law of the People's Republic of China on Scientific and Technological Progress (promulgated by the Standing

services protected by that IP, the IP "shadow tax" is transferred back to the domestic manufacturer and from the manufacturer to the U.S. patentee.[171] One might ask whether the federal government is really "reclaiming" any of the payment from foreign consumers if the payment flows to a tax-exempt private research institution, such as Stanford or the University of Chicago. In at least one sense, the answer is "yes": the tax exemption for private universities is a "tax expenditure"—economically little different from any other appropriation[172]—so the federal government is effectively claiming a share of the foreign benefits and then giving that share back to the patenting universities.

(To be sure, there are good reasons why the United States does not set its tax rate at one hundred percent.) In virtually every case, the flow of royalties from a foreign consumer to a U.S. patentee can be redescribed as (1) a payment from the foreign consumer to the U.S. government; and (2) a decision by the U.S. government as to what percentage of the royalties should flow through to the U.S. patentee. The international IP regime sets a framework for setting the size of the payment at step one but allows the producer state substantial autonomy at step two.[173]

One might question whether, as a practical matter, nation-states in fact have the capacity to tax IP income earned by domestic innovators from foreign sales. The slow progress of the

Comm. Nat'l People's Cong., July 2, 1993, rev'd Dec. 29, 2007, effective July 1, 2008), art. 21, 2007 ORDER OF THE PRESIDENT NO. 82; Intellectual Property Rights from Publicly Financed Research and Development Act 51 of 2008 § 11 (S. Afr.).

171. *See supra* note 47 and accompanying text.

172. *See* 26 U.S.C. § 501(c)(3) (2012) (providing tax exemptions for educational and scientific organizations, among others); STANLEY S. SURREY, PATHWAYS TO TAX REFORM: THE CONCEPT OF TAX EXPENDITURES vii (1973) (comparing tax incentives and direct government expenditures).

173. *See* TRIPS, *supra* note 14. In this respect, our analysis suggests a counterargument to Benjamin Roin's claim that intellectual property "limits [the government's] ability to expropriate socially valuable innovations." Roin, *supra* note 9, at 1071. In Roin's view, IP laws allow a state to make a credible commitment to innovators that the state will allow them to reap the rewards from their own knowledge production efforts. Yet nothing in IP law limits the tax rate that a state can impose on patent rents earned by its own citizens. It may be the case that as a practical matter, states that grant IP protection to knowledge goods generated by their own citizens are unlikely to negate the benefits of IP protection through tax laws. But any such limits on the taxation of patent rents arise from domestic political economy and domestic (non-IP) law, not from the international IP regime.

Base Erosion and Profit Shifting (BEPS) project, undertaken jointly by the Organisation for Economic Co-operation and Development (OECD) and the G20, might not inspire confidence on this score.[174] Our argument is not that nation-states are unconstrained in their ability to tax; in many cases, however, the principal constraint on the taxation of international IP income is political, not legal or technological. This is especially true with respect to the United States: as one of us has argued, the President and his Treasury Secretary already have the statutory authority to bring an end to strategies used by corporations such as Apple and Google to defer U.S. taxes on income from overseas sales.[175] And even if a nation-state is limited in its capacity to tax overseas income earned by domestic firms, it still has the option of making government prizes and grants conditional on the recipient relinquishing IP rights to a sovereign fund.

More fundamentally, if a state seeks to maximize the welfare of its citizens, it doesn't matter whether the *government* can capture the benefits to foreign consumers as long as someone within the state does. If a federal grant to Stanford leads to a cure for lung cancer, and Stanford patents it worldwide and licenses it to Merck, then foreign consumers who benefit from the drug must pay a patent "tax" to U.S. entities: Stanford and Merck. Even if the federal government chooses not to reclaim any of those patent rents (e.g., if the federal government exempts Stanford from paying income taxes), the benefit to foreign consumers is still internalized within the United States. A state seeking to maximize the welfare of its citizens would consider that benefit when choosing how much grant funding for lung cancer to award in the first place. Or, in the language of our model, the federal government would consider something closer to $B_{global}(x)$ than $B_{US}(x)$ when setting its level of investment x for a lung cancer-related knowledge good, which may push x closer to the global optimum.

174. *See* Reuven S. Avi-Yonah & Haiyan Xu, *Evaluating BEPS*, 6 HARV. BUS. L. REV. (forthcoming 2016) (manuscript at 3), http://www.ssrn.com/abstract=2716125 (concluding that BEPS is an "inadequate" response to global tax avoidance because it continues to rely on taxing active income at the source and passive income at residence, rather than the other way around).

175. *See* Daniel J. Hemel, *The President's Power To Tax*, 102 CORNELL L. REV. (forthcoming 2016) (manuscript at 21–24), http://www.ssrn.com/abstract=2773329 (arguing that the President and his Treasury Secretary have the statutory authority to reclassify so-called "hybrid branches" as per se corporations).

Our argument has a potential application to the ongoing policy debate at the domestic level in the United States regarding the Bayh-Dole Act, and to debates over exporting Bayh-Dole to other countries.[176] Critics of Bayh-Dole argue that the beneficiaries of public funding should be required—at least under many circumstances—to place their inventions in the public domain.[177] While we are sympathetic to arguments for greater use of non-IP mechanisms for incentivizing innovation and allocating access to knowledge goods at the domestic level, we suggest (perhaps surprisingly) that Bayh-Dole may actually encourage the use of alternatives to IP. The Bayh-Dole Act allows the United States to claim partial compensation from consumers in other countries who benefit from U.S.-funded research. The federal government may claim some of these benefits itself through taxation of U.S. manufacturers; in other cases, the benefits flow to public universities and to private research institutions that the federal government has chosen to support through tax exemptions.[178] The important point is that patenting the results of federally funded research allows the United States to internalize some of the positive externalities generated through non-IP investments in innovation.[179] Insofar as the relevant knowledge goods are global public goods and the United States is a rational, self-interested actor, we expect that the possibility of internalization will lead the U.S. to invest more in knowledge-good production through non-IP mechanisms. In other words, IP protection at the international level and non-IP innovation incentives at the domestic level may be complements, not substitutes.

To the extent this flexibility in domestic innovation policy is desirable, our analysis highlights a potential benefit of Bayh-Dole regimes that is generally overlooked. As a number of

176. *See supra* note 170 and accompanying text.

177. *See, e.g.*, Arti K. Rai & Rebecca S. Eisenberg, *Bayh-Dole Reform and the Progress of Biomedicine*, LAW & CONTEMP. PROBS., Winter/Spring 2003, at 289, 310. For a review of the controversy surrounding the Bayh-Dole Act and a critique of existing justifications for many Bayh-Dole patents, see Ian Ayres & Lisa Larrimore Ouellette, *A Market Test for Bayh-Dole Patents*, 102 CORNELL L. REV. (forthcoming 2016), http://www.ssrn.com/abstract=2748375.

178. In 2014, six of the top ten universities ranked by life sciences licensing income were public universities. *See* Brady Huggett, *Top US Universities, Institutes for Life Sciences in 2014*, 33 NATURE BIOTECHNOLOGY 1131, 1131 (2015).

179. This argument applies to prizes and tax incentives as well as grants, which are generally used as complements to, not substitutes for, IP rights. *See* Hemel & Ouellette, *supra* note 3, at 316.

scholars (including one of us) have pointed out, there are still significant costs on the other side of the ledger, which may, on net, warrant reform.[180] But we think it is worth noting that the common concern that allowing IP protection on publicly supported works requires U.S. taxpayers to "pay twice"[181] overlooks the point that *not* allowing IP protection permits non-U.S. consumers to avoid paying at all. When combined with international IP treaties, Bayh-Dole regimes may encourage states to increase direct public funding for research, alleviating Scotchmer's concern that IP treaties at the international level will cause "too little public sponsorship" at the domestic level.[182]

All of this is not to say that TRIPS places *zero* limits on a producer state's innovation policy. To comply with TRIPS, a state must undertake the administrative expense of maintaining an IP system, and it must conform its IP system to a set of core rules. It may not, for instance, limit the term of copyrights to less than the life of the author plus fifty years or the term of patents to less than twenty years, nor may it refuse to offer patents on inventions that are plainly patentable subject matter. Nonetheless, we think the constraints of TRIPS should not be overstated.[183] TRIPS still leaves countries free to use non-IP innovation incentives, and it still leaves states free to determine the size of the rewards that will go to domestic producers of knowledge goods.

180. *See* Ayres & Ouellette, *supra* note 177 (reviewing the scholarly consensus from works such as Rai & Eisenberg, *supra* note 177, that the only compelling justification for Bayh-Dole patents is that they provide an incentive to commercialize some new technologies, and proposing a "market test" to determine the least amount of exclusivity under which a licensee will commercialize).

181. *See, e.g.*, Rochelle Cooper Dreyfuss, *Collaborative Research: Conflicts on Authorship, Ownership, and Accountability*, 53 VAND. L. REV. 1161, 1194 (2000) ("The public winds up paying twice for such inventions, by both funding them and paying supracompetitive prices to use them."); Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663, 1666 (1996) (arguing that Bayh-Dole "seems to require the public to pay twice for the same invention"); Andrea Simon, Note, *A Constitutional Analysis of Copyrighting Government-Commissioned Work*, 84 COLUM. L. REV. 425, 428, 433 (1984) (arguing that government-commissioned artistic works should not be copyrightable because they are supported by "tens of billions of tax dollars annually" and "[c]opyright . . . forces the public to pay twice").

182. Scotchmer, *supra* note 23.

183. *Cf.* Ouellette, *supra* note 59, at 121–24 (noting that TRIPS does allow countries to experiment with opt-in non-IP incentive systems, but lamenting the limits TRIPS places on experimentation with substantive patent law).

B. THE SEPARABILITY OF INTERNATIONAL AND DOMESTIC ALLOCATION

The international IP system also allows states substantial flexibility in allocating knowledge goods at the domestic level. Imagine a world with two countries—say, Japan and France—that agree to provide IP protection for knowledge goods produced in the other country. If a Japanese firm receives a French patent, France must enforce a prohibition on infringement of the patent within French borders. Yet France remains free to decide that at the domestic level, the knowledge good patented by the firm ought not be allocated via the price mechanism. For instance, France may contract with the Japanese firm for an exclusive license within French borders. France may then choose any mechanism it wishes to allocate access domestically. It may, for example, auction off the exclusive license to domestic firms and allow the auction winner to control access. Alternatively, it may adopt an open-access approach whereby everyone in France can practice the invention free of charge. The agreement between Japan and France requires only that France pay the firm a bilaterally negotiated price for access to the firm's knowledge good or else enforce the firm's patent. As long as the firm and France strike a deal, France may choose from a wide menu of domestic allocative options.

This example is far from fanciful. As Benjamin Roin notes, most developed countries use a similar mechanism to allocate access to patented pharmaceuticals. After a firm obtains a patent on a pharmaceutical product, it generally agrees to sell the product in other countries at a government-set price. Those countries' governments can choose for themselves how to allocate product access within their own borders (e.g., through a single-payer system or through prescription drug insurance with a copay).[184] For example, the United Kingdom uses a system known as the Pharmaceutical Price Regulatory Scheme (PPRS) to set prices for branded medicines; it then allocates access domestically through its taxpayer-funded National Health Service.[185] If patent holders are unsatisfied with the PPRS price, they can choose to sell their products only on the private market, for which U.K. citizens can buy private insurance or

184. Roin, *supra* note 9, at 1012–13.

185. U.K. DEP'T OF HEALTH, THE PHARMACEUTICAL PRICE REGULATION SCHEME 2014, at 9–10, 18–32, 41–56 (2013), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282523/Pharmaceutical_Price_Regulation.pdf.

pay out of pocket.[186] For our purposes, the key point is that different countries can choose different domestic allocation mechanisms even while subscribing to the same global IP framework.

There is, however, a potential hurdle for states that seek to allocate goods domestically through non-price mechanisms. In our hypothetical above, France might not be willing to pay a fee to the Japanese firm for a license to distribute the invention for free domestically if it thinks that its citizens will then resell the good to consumers in other countries. (We say "might not" rather than "will not": French residents who resell the invention to foreign consumers still benefit—albeit in the form of cash rather than from the invention itself.) And the Japanese firm, for its part, might not be willing to sell a license to France if it thinks that French citizens will then resell the good in other markets and undercut the Japanese firm's prices.

In practice, we see nation-states and patent holders going to great lengths to make sure that knowledge goods distributed at a discount in one country are not later resold elsewhere. One striking example of this phenomenon comes from Egypt: Gilead Sciences, a pharmaceutical company based in California, has agreed to license the hepatitis C drug sofosbuvir to the Egyptian government, which then distributes the pills to its own citizens for free.[187] Gilead sells sofosbuvir under the brand name Sovaldi in the United States for $1000 per one-a-day pill.[188] To prevent Egyptians from reselling sofosbuvir pills abroad and undercutting Gilead's price, Egypt requires that all pills be dispensed by government pharmacies, and that all patients must hand in their last empty bottle in order to obtain a new bottle.[189] Moreover, as the New York Times reports, "[t]hose receiving new bottles must immediately unscrew the cap, break the seal and take the first pill in front of the pharmacist — making it nearly impossible to resell the bottle."[190] This example may be an extreme case, but other countries that distribute knowledge

186. Thus, when negotiating with the National Health Service, a patentee should not be willing to accept less in total profits than it could receive from these alternatives. *Id.* at 16.

187. Donald G. McNeil Jr., *Curing Hepatitis C, in an Experiment the Size of Egypt*, N.Y. TIMES (Dec. 15, 2015), http://www.nytimes.com/2015/12/16/health/hepatitis-c-treatment-egypt.html.

188. *Id.*

189. *Id.*

190. *Id.*

goods to their own citizens on a non-price basis also take measures to block resale. For example, Uruguay—which has provided free laptops to hundreds of thousands of elementary school students and teachers—uses a serial number tracking system to tie laptops to individual students and requires that recipients of free laptops sign a declaration swearing not to resell the computers.[191]

Significantly, patentees (and the nation-states that license knowledge goods from patentees for domestic distribution) cannot necessarily rely on international IP law to restrict resale. Under the doctrine known as international "first sale" or "exhaustion," the first authorized sale (including a free distribution) of an IP-protected good in one country may exhaust IP rights in that good, such that the rightsholder cannot limit resale.[192] The U.S. Supreme Court recently held in *Kirtsaeng v. John Wiley & Sons, Inc.* that international exhaustion applies to copies of a copyrighted work lawfully made abroad,[193] but the en banc Federal Circuit has since decided that *Kirtsaeng* does not change the current rule that foreign sales do *not* exhaust U.S. patent rights.[194] There is currently no international standard on IP exhaustion; rather, TRIPS explicitly states that "nothing in this Agreement shall be used to address the issue of the exhaustion of intellectual property rights."[195] The absence of an international no-exhaustion rule potentially limits (but does not eliminate) the ability of nation-states to prevent the resale of subsidized goods to consumers abroad.

* * *

The observations in this Section and the previous one can be combined: the international IP system establishes a framework for setting the size of transfers between nation-states that consume knowledge goods and nation-states that produce

191. *¿Cómo Acceder a la Compra de un Equipo Ceibal?*, PLAN CEIBAL (Jan. 28, 2015) http://www.ceibal.edu.uy/art%C3%ADculo/preguntas-frecuentes/compra/Como-acceder-a-la-compra-de-un-equipo-Ceibal.

192. Under U.S. law, "patentees cannot circumvent the application of patent exhaustion principles by distributing a product embodying the patent for free." LifeScan Scot., Ltd. v. Shasta Techs., LLC, 734 F.3d 1361, 1377 (Fed. Cir. 2013).

193. Kirtsaeng v. John Wiley & Sons, Inc., 133 S. Ct. 1351, 1355–56 (2013).

194. *See* Lexmark Int'l, Inc. v. Impression Prods., Inc., 816 F.3d 721, 760 (Fed. Cir. 2016) (en banc). We examine this international patent exhaustion issue in greater depth in a separate essay. *See* Hemel & Ouellette, *supra* note 20.

195. TRIPS, *supra* note 14, art. 6.

knowledge goods, but it does not dictate how nation-states reward knowledge-good producers within their own borders, not does it dictate how nation-states distribute knowledge goods to their own citizens. A TRIPS signatory state may still choose non-IP mechanisms both for incentivizing innovation and for allocating access to knowledge goods at the domestic level. Regardless of what mechanisms it uses at the domestic level, a knowledge-good-producing nation-state retains the option of using the international IP system to demand that other countries share in the cost of producing global public goods, with the specifics of that cost-sharing to be determined via separate negotiations.

For example, the United States could—consistent with TRIPS—establish a taxpayer-financed prize for the first inventor to patent a vaccine for the common cold, with the condition that any inventor claiming the prize must surrender the patent to the federal government. The federal government could then make the vaccine available domestically for free while charging for the right to practice the patent overseas. The U.S. and another country (say, the U.K.) could then strike a deal whereby the U.K. pays an annual fee to the U.S. in exchange for the right to distribute the vaccine within the U.K.'s borders. And the U.K. could then distribute the vaccine to its own citizens for free or at a discount. In this example, the U.S. does not use the patent system to incentivize innovation at the domestic level, and neither it nor the U.K. uses the price mechanism to allocate access.

Yet even in cases like the example above—where the producer state opts for a non-IP incentive mechanism and the consumer state chooses to allocate access on a basis other than price—TRIPS remains relevant to the outcome. That is because TRIPS sets a baseline for negotiations between producers and consumers regarding cost-sharing. To continue with the formal model from above (with S_B still the consumer nation-state and S_A the producer), TRIPS sets a floor of $P_{B|monopoly}$ on the transfer from S_B to S_A ($T_{B \rightarrow A}$). The profit that S_A can extract from S_B if it sells the relevant knowledge good at a monopoly price in S_B functions as a floor on $T_{B \rightarrow A}$ because S_A will reject any lower offer from S_B in licensing talks. (Note that S_B almost certainly could not ban trade in the relevant good without running afoul of WTO rules.)[196] At the same time, the doctrine of international

196. *See* General Agreement on Tariffs and Trade 1994, Annex 1A, ¶ 1,

exhaustion may make it difficult for S_A to extract significantly more than $P_{B|monopoly}$ from S_B. If, for example, S_A sought to demand a licensing fee from S_B in excess of $P_{B|monopoly}$, S_B could seek to acquire the relevant knowledge good on the secondary market and avoid transacting directly with S_A.

To be sure, these conclusions come with caveats, and we conclude this Part with three limits on TRIPS's effectiveness at setting $T_{B \to A}$. First, this model is obviously inapplicable for the many knowledge goods that nation-states are not required to protect under TRIPS, ranging from hygiene checklists for intensive-care units[197] to results of failed research projects.[198] TRIPS thus does little to require a state that benefits from these goods from compensating the state the produces them. Accordingly, if a producing state seeks to maximize the welfare of its citizens, it has little incentive to consider foreign benefits when setting its level of investment in goods for which the international IP system fails to enable appropriability. If there is a global underinvestment problem, states may thus need to turn to non-IP coordination mechanisms.[199]

A second qualification is that, even for goods that are clearly protectable with IP, S_B may decrease $T_{B \to A}$ by threatening to exercise its rights to issue a compulsory license under Article 31 of TRIPS. That provision allows a signatory state to make use of a patent without the holder's authorization, although the state still must provide "adequate remuneration" to the patent holder, "taking into account the economic value of the authori-

Apr. 15, 1994, 1867 U.N.T.S. 187, 33 I.L.M. 1153 (incorporating the provisions of the first General Agreement on Tariffs and Trade); General Agreement on Tariffs and Trade, art. XI, § 1, Oct. 30, 1947, 55 U.N.T.S. 194 ("No prohibitions or restrictions other than duties, taxes or other charges . . . shall be instituted or maintained by any contracting party on the importation of any product of the territory of any other contracting party [unless a specific exception applies] . . . .").

197. *See* Kapczynski & Syed, *supra* note 41, at 1902–03.

198. *See* Sean B. Seymore, *The Null Patent*, 53 WM. & MARY L. REV. 2041, 2050–52 (2012).

199. For example, Nicholson Price has explained that the nascent field of "black-box medicine"—complex computational models used for health care—depends on knowledge goods that are not protectable under many IP laws: (1) aggregated data; (2) algorithms; and (3) validation. W. Nicholson Price II, *Black-Box Medicine*, 28 HARV. J.L. & TECH. 419, 421, 443–46 (2015). He thus argues for increased use of grants and prizes in these areas. *Id.* at 449–54. Given the high cost and likely global benefits of developing black-box medical algorithms, *id.* at 437–42, a global black-box medicine institute might be worthwhile.

zation."[200] (Except in cases of "national emergency," a signatory state also must make "efforts to obtain authorization from the right holder on reasonable commercial terms" before it can make unauthorized use of the patent.)[201]

A third caveat is that if S_A can prevent other purchasers of the relevant knowledge good from reselling to S_B, then S_A might attempt to demand a payment from S_B in excess of $P_{B|monopoly}$. If S_A has complete control over resale, such that S_B can acquire the relevant knowledge good *only* through a direct transaction with S_A, then $T_{B \to A}$ could conceivably take any value in the range $[P_{B|monopoly}, B_B(x)]$. Yet even in that extreme case, TRIPS effectively sets an upper bound of $B_B(x)$ on the transfer $T_{B \to A}$ from S_B to S_A. S_B will never (or never rationally) pay more for a knowledge good than it stands to benefit from making the knowledge good freely available to its own citizens. As we discuss below, this last feature of the international IP regime is a potentially significant benefit relative to other mechanisms for setting the size of transfers from consumer states to producer states.

IV. ALTERNATIVES TO INTERNATIONAL IP LAW

So far, we have argued that for a subset of knowledge goods, coordination among nation-states can address the underinvestment problem—i.e., the problem that nation-states acting on their own will invest in the production of global knowledge goods at less than the socially optimal level. We have also argued that the international IP regime offers at least a partial solution to the problem: by requiring consumer nation-states to make transfers to nation-states that produce global knowledge goods, international IP law ensures that producer states internalize at least some of the cross-border benefits generated by their (and their citizens') knowledge production efforts. It is not immediately obvious, however, why nation-states have chosen international IP law as the framework for determining those

200. TRIPS, *supra* note 14, art. 31. 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*, 9 PLOS MED., Jan. 2012, at 3. Aggressive price regulation may delay the launch of new drugs in that state. *See* Iain M. Cockburn et al., *Patents and the Global Diffusion of New Drugs* 14 (Nat'l Bureau of Econ. Research, Working Paper No. 20492, 2014), http://www.nber.org/papers/w20492.pdf.

201. TRIPS, *supra* note 14, art. 31(b).

transfers. As we discussed in Part I.B, states generally subsidize the production of knowledge goods through a range of mechanisms beyond IP laws. By the same token, nation-states conceivably could use non-IP mechanisms to mediate transfers between consumer states and producer states. Why, then, have nation-states united on IP treaties rather than arrangements involving alternatives to IP?[202]

One answer might be that alternatives to IP such as prizes, grants, and tax credits require some sort of public finance system, and there is no global public finance system (or, at least, not much of one). Suzanne Scotchmer argued that IP treaties exist because "there are no institutions to harmonize public spending, and there are no international mechanisms to repatriate the spillovers it generates."[203] To be sure, there are international finance institutions with limited policy objectives, such as the International Monetary Fund and World Bank (the latter of which has invested more than $18 billion in R&D efforts over the past decade).[204] But this is perhaps no more than a quibble; a more substantive objection is that Scotchmer's answer just repeats the question. Why have countries chosen to coordinate on IP instead of non-IP mechanisms? It is no response to say: because they haven't set up non-IP mechanisms.

This Part attempts to offer a more thorough answer to the "Why international IP?" question. Our account is partly explanatory and partly justificatory. That is, our goal is not only to understand why—as a positive matter—nation-states have chosen international IP laws as a coordination mechanism, but also to explain why—as a normative matter—coordination around IP *makes sense*. Importantly, the two questions are not entirely separate. The puzzle of why states have chosen to coordinate on IP—and why the international IP system has persisted—becomes less of a puzzle the more rational that decision

202. *See supra* notes 16–17 and accompanying text (describing such proposals). We are unaware of any proposals for global treaties using non-IP incentive mechanisms for creative works—another indication that international IP scholars should be wary of lumping patents and copyright under one umbrella.

203. Scotchmer, *supra* note 23; *see also* SANDLER, *supra* note 86, at 76 ("The absence of a supranational government with taxing authority makes the standard tools of public finance . . . more difficult to apply at the transnational level.").

204. *World Bank Group Support for Innovation and Entrepreneurship*, WORLD BANK GRP., http://ieg.worldbankgroup.org/evaluations/world-bank-group-support-innovation-and-entrepreneurship (last visited Oct. 13, 2016).

seems to be. Even if our account does not perfectly describe the thoughts that went through the minds of government officials when they chose to coordinate on IP in the first place, it helps to explain why the regime has proven to be relatively stable.

Our account is not a simple story about administrative costs. We are agnostic as to whether the administrative costs of the international IP regime are higher or lower than the administrative costs of alternative coordination mechanisms. Indeed, if the function of international IP law is to establish a framework for setting the size of transfers from consumer nation-states to producer nation-states, then IP might seem like a very cumbersome means of achieving that objective. Rather than relying on the administrative costs justification, we instead focus on two features of the international IP regime that strike us as normatively attractive: (1) international IP law leaves nation-states with significant flexibility to develop their own mechanisms for incentivizing innovation and allocating access to knowledge goods; and (2) international IP law sets reasonable bounds on the size of transfer payments from consumer nation-states to producer nation-states.

In Part IV.A, we explain our doubts about the administrative-costs justification for IP as a coordination mechanism. In Part IV.B, we consider alternative arguments for and against an international IP regime. We close in Part IV.C with a consideration of the distributive effects of international IP and its alternatives.

A. THE ADMINISTRATIVE COSTS STORY

We have argued that the international IP system serves as a mechanism for setting the size of transfers between states that consume knowledge goods and states that produce those goods. Yet IP is not the only conceivable mechanism for mediating those transfers. One could imagine a regime whereby each nation-state agrees to contribute a fixed percentage of GDP to an international organization, and the organization then chooses promising research projects to finance with grants. Alternatively or additionally, the international organization could offer prizes to the first inventor who comes up with a vaccine for a particular disease or a treatment achieving specific results. Or perhaps the organization could simply set the size of $T_{B \to A}$ at the end of each year based on each country's consumption and production of knowledge goods over the previous twelve months (e.g., "South Korea—your idea for transparent trucks was a

clever way to reduce road accidents, so you deserve compensation from other states").[205]

The international IP regime may have advantages over these alternatives, but is one of those advantages the fact that IP saves on administrative costs? The answer is not obviously "yes." The rules of the global IP system may seem straightforward: countries are required to grant copyrights for creative works and patents for technical inventions for a set period of time (under TRIPS, no less than fifty years from publication for copyrights and twenty years from filing for patents),[206] and are required to conform their IP laws to other specifications set forth in treaties. In practice, however, the global IP system is often costly and inefficient. The costs of acquiring international patent protection include filing fees for each jurisdiction, costs of local patent attorneys or other representatives, and translation costs, making the process infeasible for all but large companies.[207] Licensing and enforcement costs are also significant. We have previously estimated the administrative cost of U.S. patent acquisition and litigation (but not including negotiation and licensing costs) to be on the order of $10 billion per year.[208] Copyright is far less costly on the acquisition side due to the international ban on copyright "formalities"[209] but copyrighted works (unlike patents) are not indexed or searchable. This, in turn, leads to transaction, negotiation, and litigation costs that often exceed the benefit from using a copyrighted work.[210]

The effectiveness of the current international IP system at setting the size of transfers between states also depends on highly variable substantive and procedural rules at the domestic level. IP rightsholders have complained of difficulty enforcing their rights in many countries, including not only China[211]

205. *See* Heather Kelly, *Samsung Working To Make Trucks 'Transparent,'* CNN MONEY (June 22, 2015), http://money.cnn.com/2015/06/22/technology/samsung-safety-truck.

206. TRIPS, *supra* note 14, arts. 12, 33.

207. *See* TRIMBLE, *supra* note 80, at 35.

208. Hemel & Ouellette, *supra* note 3, at 364–65.

209. *See* TRIPS, *supra* note 14, art. 9(1) (incorporating Articles 1 through 21 of the Berne Convention); Berne Convention, *supra* note 49, art. 5(2) (specifying that copyrights "shall not be subject to any formality").

210. *See generally* U.S. COPYRIGHT OFFICE, ORPHAN WORKS AND MASS DIGITIZATION (2015), http://www.copyright.gov/orphan/reports/orphan-works2015.pdf (describing the high costs of finding owners for many copyrighted works).

211. *See* THOMAS F. COTTER, COMPARATIVE PATENT REMEDIES: A LEGAL AND ECONOMIC ANALYSIS 345 (2013).

and India,[212] but also higher-income countries such as Japan[213] and Italy.[214] The availability and speed of injunctions and damages varies significantly between countries.[215]

IP rightsholders also face significant uncertainty about whether a given knowledge good will be protected in a given country. Even in the United States, patentable subject matter and copyright fair use are difficult to specify with any precision.[216]

To be clear, we are not arguing against variation in domestic TRIPS implementation; there are many benefits to an expansive interpretation of TRIPS flexibilities.[217] Our point is merely that the international IP system has significant costs for both private users and for nation-states that want to ensure their treaty partners are in compliance.[218] Thus, whatever the justification for using IP as a coordination mechanism, it can-

212. *See India Last in Intellectual Property Protection and Enforcement Rankings*, ECON. TIMES (Jan. 30, 2014), http://articles.economictimes.indiatimes.com/2014-01-30/news/46828590_1_property-protection-india-protection-and-enforcement.

213. *See* H. Stephen Harris, Jr., *Competition Law and Patent Protection in Japan: A Half-Century of Progress, A New Millennium of Challenges*, 16 COLUM. J. ASIAN L. 71, 82 (2002) ("Limited discovery, limited use of expert witnesses, high burdens of proof of causation and damages, and the absence of judicial authority to increase damages for willful infringement, as well as high attorneys' fees and filing fees have all been cited as features of the Japanese IP enforcement system that deprive IP owners of a meaningful private remedy for infringement in Japanese courts.").

214. The defensive strategy of filing a declaratory judgment action in Italy—with its notoriously slow procedures—to delay patent litigation elsewhere in Europe was so widespread that it became known as the "Italian torpedo." *See* Claudia Rehse, *The 'Torpedo': Recent Developments in Europe*, INTELL. PROP. MAG., Apr. 2014, at 76, 77.

215. *See generally* COTTER, *supra* note 211 (comparing patent remedies).

216. *See generally* Rebecca S. Eisenberg, *Diagnostics Need Not Apply*, 21 J. SCI. & TECH. L. 256 (2015) (outlining recent obstacles to patenting diagnostic methods); Paul Goldstein, *Fair Use in Context*, 31 COLUM. J.L. & ARTS 433 (2008) (advocating for particularity in fair use decisions). Given the difficulty of creating one workable system of fair use, it is perhaps unsurprising that TRIPS does no better at standardizing limitations on copyright than a vague three-part test: "Members shall confine limitations and exceptions to exclusive rights to certain special cases which do not conflict with a normal exploitation of the work and do not unreasonably prejudice the legitimate interests of the rights holder." TRIPS, *supra* note 14, art. 13.

217. *See, e.g.*, *supra* note 59 and accompanying text.

218. In theory, it might be possible to design a system of truly global IP protection and enforcement, but it is not obvious that the negotiation and administration costs of such a system would be an improvement on the status quo.

not be because coordination on IP is easy. International IP laws are difficult to design and even more difficult to enforce.

Of course, alternatives to international IP cannot be implemented costlessly either. But there are a number of examples of successful international coordination on incentives for technical knowledge beyond patent law, suggesting that alternatives may indeed be feasible—or at least no less feasible than global patent treaties. Countries have often collaborated on joint scientific endeavors in which they each contribute direct funding. The International Space Station has cost approximately €100 billion ($110 billion), split over almost thirty years among the United States, Russia, Canada, Japan, and ten European countries.[219] Another massive scientific collaboration, the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN), has an operating budget of about $1 billion per year, which was split among twenty-three member countries plus additional observing countries (such as the United States) in 2014.[220] The Global Influenza Surveillance and Response System, a transnational network of influenza scientists, produces annual flu vaccines and is financed by an estimated $56 million a year in contributions from a number of nation-states.[221]

Some attempt toward larger-scale cross-border coordination on R&D has been made in the European Union. Since the 2000s, the European Commission has set broad innovation-related framework goals, including an objective of increasing R&D spending as a percentage of GDP to one percent for public

219. *How Much Does It Cost?*, EUR. SPACE AGENCY, http://www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/How_much_does_it_cost (last updated May 14, 2013); *see also* NAT'L AERONAUTICS & SPACE ADMIN., FY 2016 PRESIDENT'S BUDGET REQUEST SUMMARY 1 (2015), https://www.nasa.gov/sites/default/files/files/NASA_FY_2016_Budget_Estimates.pdf (budgeting over $3 billion per year for the U.S. contribution to the International Space Station).

220. *See* Alex Knapp, *How Much Does It Cost To Find a Higgs Boson?*, FORBES (July 5, 2012), http://www.forbes.com/sites/alexknapp/2012/07/05/how-much-does-it-cost-to-find-a-higgs-boson#da1eb7764f08; Don Lincoln, *US Participation in the Higgs Discovery*, SYMMETRY (Oct. 1, 2013), http://www.symmetrymagazine.org/article/october-2013/us-participation-in-the-higgs-discovery; *Facts and Figures 2014*, CERN, http://press.cern/facts-and-figures/facts-and-figures-2014 (last visited Oct. 13, 2016).

221. Amy Kapczynski, Order Without Intellectual Property Law: The Flu Network as a Case Study in Open Science 26–27 (Mar. 12, 2015) (unpublished manuscript) (on file with authors).

spending and three percent for all spending.[222] Although the specific spending goals are nonbinding, reviews have concluded that this framework has led to a "dramatically increased focus on science and technology in national political agendas"[223] and some cross-border policy learning.[224]

While nation-states have experimented with several non-IP coordination mechanisms (and scholars have suggested still other possible approaches),[225] this does not mean the space for solutions to the underinvestment problem has been thoroughly mined. Perhaps the most intriguing possibilities arise with respect to goods for which the marginal return from additional investment falls to zero after a certain point. So long as one country invests up to that point, there is no need (and no use) for additional investment. For such goods, states may actually face an *anti*-coordination problem (more akin to "chicken" than to a prisoners' dilemma).[226] This will be the case if multiple countries would have an incentive to develop the good in a world without trade. Put differently, a chicken problem exists if, for multiple states S_i, $B_i'(x) > C'(x)$ for all $x \leq x_{global}^*$, after which $B_{global}'(x) = 0$. Thus, the globally optimal outcome can be achieved if any one country invests x_{global}^*.

Under these circumstances, *too many* countries have an incentive to develop the good, so each has some incentive to wait and hope the others will produce the knowledge first. In other words, provision of these goods is hampered by free-riding but not by uncompensated externalities. Since $B_i'(x) > C'(x)$ for all $x \leq x_{global}^*$, the fact that $B_i'(x) < B_{global}'(x)$ is not an obstacle to optimal investment. Rather, the problem is that states are prone to act strategically—and thus to invest less than they would un-

222. *See generally* Ouellette, *supra* note 59, at 114–15 (describing this framework).

223. Nina McGuinness & Conor O'Carroll, *Benchmarking Europe's Lab Benches: How Successful Has the OMC Been in Research Policy?*, 48 J. COMMON MKT. STUD. 293, 307 (2010).

224. REP. FROM THE EXPERT GROUP FOR THE FOLLOW-UP OF THE RESEARCH ASPECTS OF THE REVISED LISBON STRATEGY, THE OPEN METHOD OF COORDINATION IN RESEARCH POLICY: ASSESSMENT AND RECOMMENDATIONS 25–26, 29 (Jan. 2009), http://ec.europa.eu/invest-in-research/pdf/download_en/eur_23874_texte_web.pdf; *see also* Ouellette, *supra* note 59, at 115 (citing additional sources).

225. *See supra* notes 16–17, 60–62 and accompanying text.

226. "Chicken" is an anti-coordination game in which the optimal outcome is for players to take opposite actions, but each player prefers for the other to take the more costly action (i.e., each would prefer to have the other country invest). *See Prisoners' Dilemma*, *supra* note 33, at 1487.

der autarky with the hope that another country will pick up the slack.

A concrete example may help illustrate. Imagine that researchers identify a new chemical compound that holds promise as a cure for heart disease, and that a clinical trial to determine whether the compound is effective costs an estimated $100 million. Given that heart disease is one of the leading causes of death worldwide,[227] the expected benefits of conducting this trial likely exceeds its cost in many countries. Imagine, in a world without IP treaties or other coordination, that the United States, Germany, and Japan are each debating whether to finance the trial. Under autarky—i.e., if each country were a closed economy—each would immediately proceed. But given knowledge flows across borders, each will hope that one of the other countries will undertake the cost. This mutual waiting may have desirable effect of preventing duplicative investment. But it also may result in no state investing at all.

For this type of good (which one might call chicken-type goods),[228] one imaginable solution is an *anti*-R&D treaty. For example, if Germany and Japan can credibly commit not to finance the trial, then the good becomes a cranberry-type good from the perspective of the United States: either the United States will produce the good (which is in its interest), or the good won't be produced. For the anti-R&D treaty to succeed, it must draw the support of all but one country with the capability and incentive to produce the good under autarky.[229] Conced-

227. *See* Anthony S. Kim & S. Claiborne Johnston, *Global Variation in the Relative Burden of Stroke and Ischemic Heart Disease*, 124 CIRCULATION 314, 318 fig.1B (2011) (showing that ischemic heart disease is one of the leading causes of death worldwide, with a burden that is relatively uniformly distributed).

228. Not only do these goods present a game of chicken, but knowledge about the health effects of eating chicken might fall into this category, given widespread global chicken consumption. *See* Roberto A. Ferdman, *The Coming Global Domination of Chicken*, WASH. POST: WONKBLOG (July 14, 2014), https://www.washingtonpost.com/blogs/wonkblog/wp/2014/07/14/the-coming-global-domination-of-chicken.

229. Alternatively, an anti-R&D treaty might draw the support of all but *two* countries with the capacity and incentive to produce the relevant knowledge good themselves under autarky, thus reducing the coordination challenge for the two remaining countries to a bilateral cooperation game. More generally, if n equals the total number of countries with the capacity and incentive to produce the relevant knowledge goods themselves under autarky, then an anti-R&D treaty with $n - x$ signatories reduces the challenge of producing the knowledge good from an n-country game to an x-country game. Only when $x = 1$ does the anti-R&D treaty eliminate the free-riding risk, but an

edly, we know of no example of such an anti-R&D treaty in practice: countries have sought to implement anti-R&D treaties in other contexts (such as cloning-related research[230] and nuclear weapons research[231]), but the goal in those cases was for the treaty to cover all n nation-states rather than $n - 1$ states. Our point is not to push the anti-R&D treaty as a viable alternative to the international IP regime, but instead to emphasize that there are numerous imaginable solutions to distinct coordination problems for different types of knowledge goods.

Finally, while large-scale R&D treaties (or anti-R&D treaties) are not observed in the real world, tax treaties are. And tax treaties, like IP treaties, can address the free-rider problems highlighted by the standard account above. Countries can agree not to tax (or to tax at reduced rates) profits on knowledge goods, thus amping up incentives for innovation. Indeed, the Model OECD Convention implements a system somewhat like this: if a resident of Country X receives revenue from the use of her patent in Country Y, she is not taxed in Country Y unless she "carries on business" in Country Y "in which the royalties arise through a permanent establishment situated therein and the right or property in respect of which the royalties are paid is effectively connected with such permanent establishment."[232]

In short, we see no a priori reason why the transaction costs involved in negotiating and enforcing an international IP treaty are likely to be lower than the costs of other potential coordination mechanisms. Indeed, one might think that international IP law is quite a cumbersome way to set the size of $T_{B \to A}$. If the case for international IP rests on the administrative costs story, it is an uneasy case indeed.

B. A QUALIFIED DEFENSE OF INTERNATIONAL IP TREATIES

In our view, a stronger argument for international IP law as a mechanism for setting the size of transfers from consumer

anti-R&D treaty with $x > 1$ may still make production of the knowledge good more likely.

230. *See* Warren Hoge, *U.S. Drops Effort for Treaty Banning Cloning*, N.Y. TIMES (Nov. 20, 2004), http://www.nytimes.com/2004/11/20/world/us-drops-effort-for-treaty-banning-cloning.html.

231. *See* Treaty on the Non-Proliferation of Nuclear Weapons, *opened for signature* July 1, 1968, 21 U.S.T. 483, 729 U.N.T.S. 161.

232. MODEL CONVENTION WITH RESPECT TO TAXES ON INCOME AND ON CAPITAL ART. 12 (ORG. FOR ECON. CO-OPERATION & DEV., 2014), http://www.oecd.org/ctp/treaties/2014-model-tax-convention-articles.pdf.

nation-states to producer nation-states arises out of our observations in Part III regarding the separability of international and domestic IP policy. Those observations might translate into a normative argument in favor of a global IP accord along the lines of TRIPS: such an accord allows each signatory state to decide *for itself* how it will incentivize innovation and allocate access to knowledge goods at the domestic level, while also allowing producer states to pass some of the production costs along to other countries that use knowledge goods. In other words, TRIPS allows each country a measure of autonomy at the domestic level, subject only to the constraint that no country can use a knowledge good generated in another signatory state without the other state's consent (or without the consent of the inventor in the other state who patented the product in question).

To be sure, the use of IP as a global coordination mechanism does not guarantee total freedom of choice for individual states with respect to innovation incentives and allocation of access at the domestic level. As discussed above, each TRIPS signatory must maintain an IP system and must offer rewards at least as attractive as those a knowledge producer could expect from IP. A country's right to use knowledge goods originating elsewhere also remains subject to the producer's veto. And the potential for bargaining frictions is considerable, as producers and consumer nations each seek to capture the surplus from trade. So too, the use of IP as a global coordination mechanism is likely to lead to a transfer of wealth from nations that are primarily users to nations that are primarily producers. (We consider this issue in Part IV.C.)

Moreover, this "autonomy advantage" is not entirely unique to IP. If, for instance, TRIPS were replaced by a global prize system financed by mandatory national contributions, individual countries still could adopt alternative mechanisms to encourage domestic innovation and still could use a price mechanism to allocate access to knowledge goods at the domestic level. For example, imagine that a global prize fund offers a reward for the first team to invent a successful vaccine for the common cold. The United States could decide that intramural government research is the most promising strategy for coming up with a cure and could assign a group of scientists at the NIH to pursue the project. If the NIH scientists were the first to succeed, the federal government could claim the prize itself. And if the United States thought that access to the cold vaccine

should be allocated on a user-pays basis, it could finance its contribution to the global fund by imposing a tax or fee on patients who receive the vaccine.

Other potential international policies are somewhat "stickier," in the sense that they make it harder for any one country to adopt a different approach. Say that countries agree to establish an international R&D organization, again funded through mandatory national contributions, that will dispense grants to university researchers across the globe who are pursuing promising projects. A country that preferred to rely on the market (or on intramural research) could still do so, but it would have no way of getting other states to share a portion of the costs. The country could, though, still choose how to finance its contribution to the international organization—e.g., through a broad-based tax or through a targeted tax on knowledge goods that replicates the user-pays aspect of the IP system. So while it is not the case that all potential international innovation policies are completely separable from domestic ones, it is the case that convergence around an international IP regime, an international prize fund, or an international R&D organization would still leave wide leeway for states to choose different ways to finance innovation themselves.

The international IP regime is distinct from alternative coordination mechanisms such as a global prize fund or a global R&D organization in one important respect: as noted above, the transfer from a consumer nation-state to a producer nation-state in an international IP regime ($T_{B \to A}$) is bounded. Even with some amount of price discrimination, $T_{B \to A} \leq B_B(x)$. A producer cannot charge a consumer state more than the consumer state stands to benefit from the producer's knowledge good. The consumer state will reject any deal that requires it to pay more than it gets.

To be sure, there may be cases in which a patent is granted for an invention that is obvious, or in which a patent is granted to an applicant who was not the first discoverer. Note, though, that consumer nation-states retain a powerful hedge against this risk: they can decline to grant a patent for any invention that is not "new" or that does not "involve an inventive step."[233] Thus, if producer nation-state S_A grants a patent to a domestic applicant for an "invention" that is obvious, and the domestic applicant then seeks protection in S_B, then S_B has the option to

233. TRIPS, *supra* note 14, art. 27(1).

deny the application.[234] If S_A disagrees with that determination, its only legal recourse is to resort to the dispute resolution mechanisms set forth in TRIPS.[235]

No such assurance exists with respect to a global prize fund or a global R&D organization. As discussed above, nation-states are likely to favor spending on knowledge goods for which domestic benefits are large relative to global benefits: the United States, for example, almost certainly has more interest in treating diabetes than treating diarrheal diseases (even though the two types of ailments kill approximately the same number of people worldwide each year).[236] Depending on who controls the levers of power, a global prize fund or global R&D organization might divert more of its spending to "first-world problems" than to the dilemmas facing lesser-developed nations. And it seems to us a safe assumption that wealthier nations will exert outsized influence on whatever international institution might replace the IP regime. At the very least, the international IP regime has the following argument going for it: citizens of poorer countries don't have to pay for knowledge goods that they don't use. A global prize fund or global R&D organization financed by mandatory national contributions offers no such guarantee.

Our focus on the separability of international and domestic innovation incentives also suggests that some of the criticisms of international IP law are misplaced. Consider, for example, Scotchmer's worry that international IP law will lead to deadweight losses that could be avoided if R&D were publicly financed.[237] This concern follows from the view that the IP shadow tax, as the equivalent of a concentrated sales tax, imposes greater deadweight losses than other innovation incentivizes financed via broad-based taxation.[238] But as we emphasized in Part III, harmonized IP protections at the international level do not preclude any individual nation from relying on broad-based taxation to finance the allocation of knowledge goods at

234. *Id.* art. 27(1) n.5 ("For the purposes of this Article, the term[] 'inventive step' . . . may be deemed by a Member to be synonymous with . . . 'non-obvious' . . . .").

235. *See id.* art. 64.

236. *The Top 10 Causes of Death*, WORLD HEALTH ORG., http://www.who.int/mediacentre/factsheets/fs310/en/ (last updated May 2014). Diabetes is much more prevalent in high-income countries, and death from diarrheal disease is much more common in low-income countries.

237. Scotchmer, *supra* note 23, at 436.

238. Gallini & Scotchmer, *supra* note 3, at 54.

the domestic level: absent a complete bargaining breakdown, a state will be able to purchase a license to a patented knowledge good from the producer at a price equal to or less than the value of the good to its own citizens, and can then choose to make the good available to its own citizens at marginal cost (or for free). So even if proprietary pricing does impose greater deadweight loss than broad-based taxation, that does not mean that harmonized IP protection is itself inefficient.

At any rate, the assumption that proprietary pricing imposes greater deadweight loss than taxation does not necessarily hold for all countries. The assumption depends on the existence of a reasonably efficient domestic finance system—a condition not everywhere found. Countries differ dramatically in the structure of their tax systems and in the size of the resulting deadweight loss from revenue raising.[239] Meanwhile, the deadweight loss from proprietary pricing under an IP regime depends on the elasticity of demand for the patented product. For instance, if demand is perfectly inelastic (i.e., if consumers will purchase the same quantity regardless of price), then the deadweight loss of proprietary pricing is zero.[240] In that event, reliance on IP will be more efficient than all but the ideal tax system.[241]

The efficiency of conventional public finance mechanisms versus the IP shadow tax will vary not only with the efficiency of the tax system, but also with other characteristics of the state, including both its bureaucratic capabilities and political economy constraints on what policies it is able to promulgate. Amy Kapczynski notes that the IP literature "typically describe[s] the state in its first instance as inertial, heavy, bureaucratic, ill-informed, and perilously corruptible and corrupt."[242] Mariana Mazzucato has recently challenged that pessimistic view of the state, arguing that for numerous breakthrough technologies, the state has in fact acted as "a lead risk-taker and market-shaper" rather than "an inert bandage for

239. *See* Gary S. Becker & Casey B. Mulligan, *Deadweight Costs and the Size of Government*, 46 J.L. & ECON. 293, 335 tbl.D1 (2003) (showing summary statistics for measures of tax efficiency).

240. MASSIMO MOTTA, COMPETITION POLICY: THEORY AND PRACTICE 43 n.11 (2004).

241. For a more elaborate argument suggesting that the optimal innovation policy involves a mix of proprietary pricing and financing through broad-based taxation, see E. Glen Weyl & Jean Tirole, *Market Power Screens Willingness-To-Pay*, 127 Q.J. ECON. 1971 (2003).

242. Kapczynski, *supra* note 5, at 131–32.

areas underserved by the market . . . ."[243] We do not think that either one of these visions will always prevail. Government-set rewards depend on state officials acting in the public interest, and are thus unlikely to succeed in nation-states with high levels of corruption or inefficient bureaucracies.[244] Market-set rewards such as tax incentives[245] and patents give less discretion to state officials, but they still depend on the ability of the state to design efficient systems for screening the projects that receive either type of reward.

The key point is this: for some products and in some countries, proprietary pricing will be more efficient than taxation as a means of raising revenue to finance innovation, while for other products and in other countries, the reverse will be true. We cannot confidently say that on balance efficiency considerations weigh in one direction or another in the IP-versus-non-IP debate. Efficiency considerations do suggest, however, that optimal innovation policy is country- and case-specific. A prize system may be inefficient for countries in which the deadweight loss from taxation is high and demand for the prized invention is inelastic. At the same time, another country with a better-functioning tax system—and where demand for the relevant knowledge good is more elastic—may want to finance innovation through broad-based taxation rather than propriety pricing. Thus, to the extent that efficiency arguments point in any direction, they point in favor of global arrangements that allow for diversity and maximize domestic autonomy.

C. DISTRIBUTIVE CONSIDERATIONS

Critics of the international IP regime frequently focus on the distributive consequences of IP rights.[246] According to Peter Gerhart, "It is the distributive dimension of intellectual property policy that makes existing international institutions such an

243. MARIANA MAZZUCATO, THE ENTREPRENEURIAL STATE: DEBUNKING PUBLIC VS. PRIVATE SECTOR MYTHS 9–10 (2013).

244. *Cf. Corruption Perceptions Index 2014*, TRANSPARENCY INT'L, https://www.transparency.org/cpi2014 (last visited Oct. 13, 2016) (reporting perceived public sector corruption across countries).

245. The description of tax incentives as a "market-set reward" may surprise readers unfamiliar with our prior work. Elsewhere, we have noted that in the case of R&D tax credits and patent boxes, "nongovernment actors decide which inventions are worth pursuing and which projects are most likely to yield the inventions in question" while "[t]he government simply enhances the ultimate reward." Hemel & Ouellette, *supra* note 3, at 332.

246. *See supra* notes 57–58 and accompanying text.

unsound mechanism for determining global rules for intellectual policy . . . ."[247] Gene Grossman and Edwin Lai conclude that harmonization of IP protections across countries "has more to do with distribution than with efficiency, and that incorporation of such provisions in a treaty like TRIP[S] might well benefit the North at the expense of the South."[248]

We do not dispute the claim that international IP treaties such as TRIPS, insofar as they strengthen IP protections in consumer countries, will increase the wealth of information-producing nations. But international IP treaties are only one element within the constellation of policies affecting the global distribution of wealth. Every year, industrialized nations transfer significant sums of wealth to poorer countries—through official development assistance as well as other mechanisms. In 2013, official development assistance from twenty-eight wealthy countries to poorer nations totaled $134.8 billion.[249] Wealthy countries enjoy substantial autonomy over the amount and allocation of their foreign aid budgets—a fact that no international IP treaty can change. Thus, if an international IP treaty such as TRIPS enriches wealthy countries at the expense of their poorer counterparts, wealthy countries can offset that redistribution of wealth via direct transfers. Conversely, if TRIPS were replaced by an IP regime that shifts wealth to poorer countries, wealthy nations could counterbalance that shift by reducing their foreign aid outlays.[250] At the end of the day, wealthy nations decide whether—and how much—they wish to redistribute wealth across borders. Unless a new IP regime results in a North-to-South redistribution of wealth that exceeds the existing amount of foreign aid (a possibility we think unlikely),[251] international IP treaties will dictate the form—but not the sum total—of global wealth redistribution.

247. Peter M. Gerhart, *The Tragedy of TRIPS*, 2007 MICH. ST. L. REV. 143, 144; *see also supra* note 28 and accompanying text.

248. Grossman & Lai, *supra* note 5, at 1650.

249. *Foreign Aid Reaches Record High*, THE GUARDIAN (April 8, 2014), https://www.theguardian.com/global-development/2014/apr/08/foreign-aid-spending-developing-countries.

250. Just because wealthy nations *could* counterbalance redistribution through IP with adjustments in foreign aid does not mean that they *would*. As discussed in Parts II.C and II.D, the behavior of nation-states is not always best described through rational actor models, and it is possible that domestic lobbyists could be more successful pushing for IP rules that benefit foreign countries than for more direct foreign aid.

251. By one estimate, TRIPS resulted in a net rent transfer of $5.76 billion (in 1995 dollars) to the United States. *See* KEITH E. MASKUS, INTELLECTUAL

This is not to say that the distributive consequences of international IP treaties are nil. International IP treaties likely lead to transfers of wealth *among* industrialized nations—transfers that cannot be offset through changes in the amount of foreign aid (since industrialized nations do not typically give foreign aid to each other).[252] Some might consider such transfers to be normatively desirable based on a user-pays principle.[253] Others might argue that even if the distributive consequences of international IP treaties are largely limited to the industrialized world, egalitarians ought to oppose policies resulting in wealth transfers from industrialized nations with lower per-capita GDPs to the United States and Germany (the primary TRIPS beneficiaries). Note, though, that the international IP regime does not always benefit richer industrialized nations at the expense of middle-income ones: some of the net losers from TRIPS (e.g., Norway) have higher per capita incomes than some of the net winners (e.g., Italy).[254] The key point is that once one recognizes that the North-South distributive consequences of international IP treaties can largely be offset through adjustments to foreign aid, the normative debate over international IP treaties takes on a different tone. One might favor the redistribution of wealth from industrialized nations to developing countries while also believing that user-pays is an appropriate framework for allocating the costs of information production within the industrialized world. On that view, the distributive consequences of international IP treaties such as TRIPS begin to look quite attractive.

PROPERTY RIGHTS IN THE GLOBAL ECONOMY 184 tbl.6.1 (2000); *see also* Phillip McCalman, *Reaping What You Sow: An Empirical Analysis of International Patent Harmonization*, 55 J. INT'L ECON. 161, 179 tbl.4 (2001) (estimating that TRIPS resulted in a net transfer of $4.553 billion for patents applied for in 1988). Meanwhile, U.S. foreign aid in 1995 totaled $12.3 billion, and U.S. foreign aid has more than doubled (in real-dollar terms) since the mid-1990s. *See* CURT TARNOFF & MARIAN LEONARDO LAWSON, CONG. RESEARCH SERV., R40213, FOREIGN AID: AN INTRODUCTION TO U.S. PROGRAMS AND POLICY 29–31 tbl.A-2 (2011). These figures suggest that even if TRIPS were entirely eliminated, the United States could easily offset the distributive consequences of that (dramatic) reform by reducing its foreign aid outlay.

252. *See* McCalman, *supra* note 251, at 179 tbl.4 (calculating that Canada, Brazil, and the United Kingdom were the biggest net losers—in absolute terms—from the transition to TRIPS).

253. *See, e.g.*, Hemel & Ouellette, *supra* note 3, at 350–51 (discussing the normative arguments for and against a user-pays approach).

254. *See* McCalman, *supra* note 251, at 179 tbl.4.

Critics of the international IP regime might respond that even though the distributive consequences of international IP law can be offset through foreign aid, political considerations make such offsets unlikely.[255] After all, "more foreign aid" is rarely a winning platform plank in a rich-world democracy.[256] Yet those who criticize international IP law on distributional grounds bear the additional burden of showing that their preferred alternative—whether it be a global prize fund, a global R&D organization, or some other mechanism—would yield a more desirable distributive outcome. If wealthy producer nation-states have managed to use international IP law to extract rents from consumer nation-states, what is to prevent wealthy producer nation-states from using a global prize fund or a global R&D organization to extract rents as well? Until critics of international IP law can answer that question, the case against international IP law on distributive justice grounds will be as uneasy as the case *for* international IP law on administrative cost grounds.

CONCLUSION

Readers of our prior work might at this point expect a recantation. In an earlier article, we advocated for "innovation policy pluralism," arguing that a mix of IP and non-IP incentives is in most cases preferable to exclusive reliance on IP alone.[257] Here, we defend (with qualifications) an international status quo that is (with exceptions) principally oriented around IP. Are these two positions inconsistent?

To the contrary, we think that our analysis of international IP law strengthens the case for innovation policy pluralism at the domestic level. One concern regarding the use of non-IP innovation incentives at the domestic level is that nation-states

255. *Cf.* Lee Anne Fennell & Richard H. McAdams, *The Distributive Deficit in Law and Economics*, 100 MINN. L. REV. 1051 (2016) (noting, in the domestic context, that "political action costs" may stand in the way of "efficient" redistributive schemes).

256. *See* Kevin Robillard, *Poll: Most Only Want Foreign Aid Cuts*, POLITICO (Feb. 22, 2013), http://www.politico.com/story/2013/02/poll-most-only-want-foreign-aid-cuts-087948. *But see Everything You Need To Know About the Parties' Platforms, from Taxes to Terrorism to the Environment*, NAT'L POST, http://news.nationalpost.com/news/canada/canadian-politics/everything-you-need-to-know-about-the-parties-platforms (last updated Oct. 13, 2015) (noting that the Liberals, who went on to win a decisive victory in the October 2015 Canadian federal election, promised to "[r]everse the decline in foreign aid").

257. *See* Hemel & Ouellette, *supra* note 3, at 310.

that subsidize knowledge production through such mechanisms will not be able to internalize the benefits that accrue to other states.[258] In this Article, we have offered several reasons why that concern is misplaced. As we demonstrated in Part II, not all knowledge goods are global public goods—and even for global public goods, nation-states may have strong incentives to subsidize production through public finance mechanisms under certain circumstances. And as we showed in Part III, nation-states that subsidize knowledge production through non-IP incentives at the domestic level still can use international IP law to secure partial compensation from consumer states. Meanwhile, international IP law leaves consumer states free to experiment with non-price-based mechanisms for allocating access to knowledge goods. And unlike IP at the domestic level, international IP law need not lead to any deadweight loss from proprietary pricing.[259]

In sum, international IP law does not direct nation-states as to how they should incentivize innovation or allocate access to knowledge goods at the domestic level. Instead, the role of the international IP regime is to set the size of transfers from states that consume knowledge goods to states that produce them, while leaving both consumer states and producer states with substantial autonomy over the production and consumption of knowledge goods inside their own borders. The international IP regime thus does not supplant nation-states as the principal players in innovation policy. Rather, international IP law expands the range of innovation policy possibilities that nation-states can explore.

258. *See id.* at 367–68.

259. This is not to say that international coordination around non-IP mechanisms is necessarily misguided. It is only to say, as emphasized throughout, that international coordination on IP does not stop states from adopting IP alternatives at the domestic level—and in some circumstances may make it easier for states to do so.