Between Spanish Huertas and the Open Road: A Tale of Two Commons?
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Why are highways, city streets, and sidewalks in almost all cases, in all market economies, managed as open-access commons? Should databases be in the public domain as in the U.S., or subject to some form of copyright-like regime as in Europe? Is there a role for next generation WiFi spectrum commons strategies in the construction of the ubiquitous computing environment, or should we auction off all remaining spectrum in property-like models? These and similar institutional design questions, great and small, require us to have a general understanding of the role commons play in contemporary market economies.

Elinor Ostrom's 1990 *Governing the Commons*[1] marked a turning point in the legitimacy of talking about the commons on the background of a dominant neoclassical understanding of property and the Tragedy of the Commons, leavened only mildly by new institutional economics. If in 1986 Carol Rose's *Comedy of the Commons* was an outlier,[2] by 2011 the subject has become mainstream. But in the process of creating a legitimate space for studying the commons, Ostrom's emphasis on a very carefully delineated subset of limited common property regimes (CPRs) largely overshadowed and obscured the exploration that Rose began, of understanding basic, ubiquitous elements of market economies in terms of the interaction of property and commons. Indeed, part of securing a safe intellectual domain for CPR studies included a strict insistence on "the difference between property regimes that are open-access, where no one has the legal right to exclude anyone from using a resource, and common property, where members of a clearly defined group have a bundle of legal rights including the right to exclude nonmembers from using that resource "[3] Since then we have had two lines of inquiry under the umbrella term of "the commons," each concerned with quite different classes of problems and solutions. Perhaps there is no grand unified theory of commons. Perhaps there is. But the basic theoretical framework of contemporary studies of the commons needs to deal with two distinct paradigm cases that mark our understanding of commons. On the one hand, we have the pastures and irrigation districts that symbolize the work Ostrom pioneered; on the other hand, we have highways, streets and sidewalks, as well as the traditional, uncontroversial aspects of the public domain: like patent and copyright term limitation, or the necessity of inventive step or nonobviousness for patentability. No theory of the commons can afford to exclude either. Understanding what it is that can include, on the one hand, Alicante's refined water scrip market, with its highly liquid market in divisible and tradeable rights, and, on the other hand, highways and the public domain in knowledge, information, and culture, is the challenge of any comprehensive theory of the commons.

The hallmark of the first line of work is a focus on local, non-state-based institutional design for sustainable governance of resources as to which a defined set of claimants: farmers who are part of an irrigation district or a pasture, members of a patent pool, lay claim in common. Common property regimes are property regimes applied to resources that require larger scale utilization than would be efficient in small, individually-owned parcels. If this line of work indeed includes Alicante, then what

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1 Elinor Ostrom, *Governing the Commons* (1990).

2 Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. Chic. L. Rev. 711 (1986).

3 Charlotte Hess and Elinor Ostrom, Ideas, Artifacts and Facilities: Information as a Common Pool Resource, 66 L. & Contemp. Probs. 111, 121 (2003).

makes it "commons" must be an absence of a state-created property system. The primary policy implications of this line of work are that in the management of resources, sometimes introducing a government management policy will undermine a well-functioning, collectively-created system better tailored to local conditions than a standardized institutional framework could.[4] This line of work is capacious enough to have been claimed by authors concerned with much more state-based systems for managing resources whose scale requires common ownership, such as corporations[5] and partnerships.[6]

A second line of work is concerned with substantial resource sets in modern market economies, increasingly so in the global networked information economy, governed so that more-or-less anyone may use the resource set and no one, or no group, has exclusive rights as against anyone else. These include both resources that are provisioned and regulated by government, but whose governance entails open access under symmetrical use constraints, like highways, as well as privately provisioned resources whose outputs were not subject to exclusive property rights, but rather subject to a regime of full or partial open access, like inventions and cultural goods subject to the public domain out of which patent and copyright claims are carved, and into which the creations return after a while or under certain conditions. This was the line of work that Rose launched in her exploration of the idea of "inherently public property" under the title "*Comedy of the Commons*," where "inherent" meant that common law doctrine created rights in roads, waterways, or public squares for the unorganized public, rather than a particular subset of users or government as proprietor.[7] This was the concern that animated much of the work that focused on the public domain in copyright and patents since 1990, from Litman and Samuleson to Boyle, which emphasized the neglected importance of the public domain as a resource set to which anyone has access without permission.[8] And this was the concern that I emphasized in my work on the commons,[9] that Larry Lessig emphasized in his,[10] and whose most recent well worked out version is Brett Frischmann on infrastructure and commons management.[11] The practical design and theoretical questions of why and how you would sustainably manage an irrigation system as common property held by several hundred or even thousands of claimants is quite distinct from the question of why or how you would manage a transportation infrastructure that handles hundreds of millions of people a day as a commons, or a common carrier; why you would insist that patents expire after twenty years, or that data be insusceptible to exclusion, so that anyone, member of a patent pool or not, can build on that innovation or data. There are important and useful overlaps between the two lines of research. Studying Wikipedia internal governance benefits greatly from CPR literature. Understanding the transformative implications of Wikipedia, or why it ultimately overshadowed Microsoft's Encarta, requires more of an understanding of commons unmodified; in this case, the benefits of open access to knowledge to the public at large and to the rate of innovation

4 Hess and Ostrom, *supra*, 123 and footnotes 56-59 extensive bibliography.).

5 *Id.* p. 123, citing Thráinn Eggertsson, Economic Behavior and Institutions 223-28 (1990); Thráinn Eggertsson, *The Economic Rationale for Communal Resources*, *in* I A Conference on Common Property Regimes: Law and Management of Non-private Resources 41 (Erling Berge ed., 1993); Dean Lueck, *Common Property as an Egalitarian Share Contract*, 25 J. ECON. BEHAV. & ORG. 93, 93-108 (1994).

6 Hanoch Dagan and Michael Heller, *The Liberal Commons*, 110 Yale L.J. 549 (2001). (hereinafter Dagan and Heller).

7 Rose, 1986.

8 Jessica Litman, The Public Domain, 39 EMORY L.J. 965, 975 (1990);.

9 Commons as a Neglected Factor of Information Policy (TPRC 1998); Overcoming Agoraphobia, 1998; From Consumers to Users (2000); Property, Commons, and the First Amendment: Towards a Core Common Infrrastructure (2001); The Political Economy of Commons (2003).

10 Lawrence Lessig, Code and the Commons, (1999), The Future of Ideas: The Fate of the Commons in a Connected World (2002).

11 *An Economic Theory of Infrastructure and Commons Management,* 89 Minn. L. Rev. 917 (2005).

(refinement and accession) of the public goods—information and knowledge—treated as commons.

Commons, including open access commons, almost never means lawlessness or anarchy[12] (except in the Proudohnian sense of private self-organization). It means freedom-to-operate under symmetric constraints, available to an open, or undefined, class of users. Rules of the road on the open highway are the most basic instance. They are marked by an absence of asymmetric power to determine disposition of the resource. Experiments to institute minimal pricing systems, such as pay access to HOV lanes,[13] or congestion pricing, are (a) the exception, not the rule, and (b) available on nondiscriminatory, fixed terms to anyone, more like common carriage than a spot market in roadway capacity. In Hohfeldian terms, they are marked by privileges and immunities for an undefined public, rather than rights and powers for a defined person or persons.

Markets provide the flexibility needed for specialization and innovation by easing trade in diverse goods and services through a standardized medium of exchange. Their openness and capacity for dynamic reallocation of resources is subject to standard limitations: transactions costs, information shortfalls, and strategic behavior in the presence of market power where competition is lacking. Commons provide similar flexibilities for dynamic allocation and reallocation of the resources they govern, so that no one's permission (with market, at least some*one*'s permission is necessary, the prior owner of a resource or flow unit) is necessary. Their primary limitation is capacity: either because they are underprovisioned in the absence of appropriation-seeking investment, or because of congestion, where the resources are congestible. Whether markets or commons will provide a better institutional framework for a given resource will depend on whether the resource is more or less prone to transactions costs, public goods characteristics, and the exercise of market power, on the one hand, and the extent to which it is susceptible to congestion or underprovisioning, given available solutions to either limitation, on the other hand. That is why classic public goods like information goods are subject to a commons institutional framework—the public domain—and why even partially congestible resource with high positive externalities and high risk of the presence of market power—like highways or public utilities—are managed as commons provisioned with high levels of public investment to compensate for the risk of underprovisioning, or using regulated monopoly frameworks that allow rent extraction to cover the provisioning costs but insist on nondiscrmiinatory terms of use to preserve the flexibility of transaction-free, permission-free use of the resource, for at least the parts most prone to market power, like last mile electricity distribution systems.

Once we accept that public highways or the public domain are no less paradigm cases of the commons than the Spanish Heurtas or Swiss pastures, it becomes clear that commons are not only, or even primarily, instances of self-governance applied to discrete resource sets. They are as ubiquitous in, and fundamental to, the global networked information economy as is property; neither institutional system can thrive without the other. Few scholars who study patent pools believe that this study replaces exploring the effects of, say, patent term or nonobviousness.[14] The two lines of inquiry complement each other: the former is a study in the tradition of CPRs, the latter a study of the proper

12 See *e.g.*, Dagan and Heller at ___.

13 Lior Strahilevitz,

14 It is possible to interpret some work that focused purely on transactions costs, like Merges's work on collective rights organizations, to imply that if transactions costs were largely eliminated the public domain would be unnecessary and counterproductive. Robert Merges, *Contracting Into Liability Rules: Intellectual Property Rights and Collective Rights Organizations* (84 Calif. L. Rev.1293 (1996). This seems to be too strong of an interpretation that would completely ignore the nonrivalry and positive externalities implications of information, knowledge, and culture, where any exclusion involves trade offs.

demarcation of property and commons in designing a well-functioning innovation system. More generally, commons are a fundamental element in any well-functioning market economy. This includes paradigmatic commons like roads, highways, and urban sidewalks, basic data, scientific research and the majority of human knowledge that has entered the public domain; as well as, public utilities like electricity, water, and sewage; major shipping lanes and standards, from weights and measures to shipping container specifications; telecommunications networks, and legality itself. These are all commons, in the symmetric-freedom-to-operate sense, without which the property system could not function. They include allocation models for classic public goods, major infrastructure, and platforms for trade and innovation. Without ubiquitous, sustained, open commons the global networked information economy would come to a standstill.

Commons, common property regimes, and legal scholarship on information policy.

In the past two decades, the concept of the commons has gradually been rehabilitated in law, economics, political science, and environmental sciences after a long period in the cold. In legal academia, Carol Rose's *Comedy of the Commons* in the mid-1980s was the first important move, looking at roads, public squares, and navigable waters as core examples. Rose emphasized what would later be named in economics "network effects" and positive spillovers, as well as hold-out problems for socially valuable activities as the core answers to the puzzle of why, even where well-defined property rights existed, some core economic resources absolutely central to the proper functioning of an economy built on trade gravitated toward commons. The most important boost to this newfound respectability came from the extraordinarily careful work of Elinor Ostrom and her many collaborators and colleagues on common pool resource systems that were managed as common property regimes, which she encompassed under the label of "commons" in her book title. The commons became sexy (academically) within the decade, and the term was incorporated into other concepts, including famously "anticommons,"[15] "semicommons,"[16] and "creative commons,"[17] as well as "contractually reconstructed commons,"[18] "liberal commons,"[19] and, "culturally constructed commons."[20]

In 2001, at the first conference organized by the Center for the Public Domain at Duke Law School, Ostrom first addressed a crowd of legal academics then interested in applying the concept of the commons to problems of information and cultural production. She identified three definitions then in use in the legal literature. The earliest, Jessica Litman's definition as part of her 1990 description of *The Public Domain*: "In the intellectual property context, the term describes a true commons comprising elements of intellectual property that are ineligible for private ownership. The contents of the public domain may be mined by any member of the public."[21] Next was my definition in *The Commons as Neglected Factor of Information Production*: "The commons refers to institutional devices that entail government abstention from designating anyone as having primary decision-making

15 Michael Heller, The Tragedy of the Anticommons: Property in the Transition from Marx to Markets, 111 Harv. L. Rev. 621 (1998).

16 Henry Smith, Semmicommon Property Rights and Scattering in the Open Fields, 29 J. Legal Studs. 131 (2001).

17 Www.creativecommons.org.

18 J.H. Reichman and Paul Uhlir, A Contractually Reconstructed Research Commons For Scientific Data in a Highly Protectionist Intellectual Property Environment, 66 Law & Contemporary Probs 315 (2003) (originally presented at the Duke Conference on the Public Domain, 2001)..

19 Dagan and Heller, *supra*.

20 Michael Madison, Brett Frischman, and Katherine Strandburg, Constructing Commons in the Cultural Environment, 95 Cornell Law Review (2010).

21 Jessica Litman, The Public Domain, 39 EMORY L.J. 965, 975 (1990).

power over use of a resource. A commons-based information policy relies on the observation that some resources that serve as inputs for information production and exchange have economic or technological characteristics that make them susceptible to be allocated without requiring that any single organization, regulatory agency, or property owner clear conflicting uses of the resource." [22] And finally Larry Lessig's formulation in *Code and the Commons*: "The commons: There's a part of our world, here and now, that we all get to enjoy without the permission of any." [23] Ostrom's primary critique of our work was that we in the legal academy were too focused on the public domain as the core instance, and were unable to answer the question of what is the commons: "Is it a given right, a nonassigned right, an unclaimed right, an unmanaged resource, or something that should just be there in a democracy? ".[24] Hess and Ostrom then proceeded to lay out the analytic framework that made *Governing the Commons* and the work on common property regimes so successful an institutionalist method of critiquing the neoclassical model of property. In particular, on the characteristics of the resource set, Ostrom emphasized the centrality of high subtractibility to the definition of common pool resources, and underscored that what these resources shared with public goods was the difficulty of exclusion, not the nonrivalry.[25] On the characteristics of the institutional regime, Ostrom emphasized, as she had in *Governing the Commons*, the "confusion between common-property and open access regimes." The combination of these distinct characteristics of common-property regimes lead Hess and Ostrom to caution that: "analyzing the whole ecosystem of scholarly information is much more tenuous than in *Governing the Commons* .... Information... often has complex tangible and intangible attributes: fuzzy boundaries, a diverse community of users on local, regional, national, and international levels, and multiple layers of rule-making institutions. ... Distributed digitized information, such as that on the Internet, adds more layers of complexity to the flow .... [D]igital information, though subject to congestion, is generally nonsubtractive; thus, the resource flow is not subject to erosion (deterioration) in that same way that physical information artifacts are (books, journals, newspapers, etc.) ."[26] To overcome these difficulties, Hess and Ostrom chose to apply their familiar framework to the most "well-behaved" problem associated with information and knowledge: libraries. Libraries are "easy" for the literature on common pool resources because they are hard to characterize as problems of information economics. Unlike their knowledge content, copies of books are rival and excludable. Library stacks, reading rooms, and budgets are constrained. These problems were the familiar problems of congestable facilities and subtractable (or rival) goods, meant to be shared by a moderately large and definable set of users, applied near a domain that raises the real challenges to the traditional model of property when applied to innovation, knowledge, culture, and communications.

The challenge that Ostrom laid down a decade ago: the need for a stable shared definition within law and legal analysis of "the commons," has not been resolved. As recently as 2010, when Madison, Frischmann, and Strandburg were pressed to provide such a definition as part of their project to focus legal academic work on "culturally constructed commons" on the model of Ostrom's studies, they responded with "The commons framework for collecting case studies is grounded on the premise that existing theories may prove to be inadequate. New theories may need to be developed. "[27] While

22 Yochai Benkler, The Commons as a Neglected Factor of Information Policy, Remarks at the Telecommunications Policy Research Conference (Sept. 1998) .

23 Lawrence Lessig, Code and the Commons, Keynote Address at the Conference on Media Convergence, held at Fordham University Law School (Feb. 9, 1999), available at http://cyber.law.harvard.edu/works/lessig/fordham.pdf .

24 Hess & Ostrom, supra, at 114.

25 *Id.* at 120.

26 Hess & Ostrom, 132-134.

27 Madison, Frischmann, Strandburg, Reply, 95 Cornell L. Rev. 839, 840 (2010).

the effort of these and other authors to leave a big tent and draw in many diverse scholars is worthy and legitimate, the challenge presented by Ostrom a decade ago and others since is also a legitimate one. As legal scholars, rather than as social scientists observing various cultural production practices, what can we say about the characteristics of "commons" as a distinct legal institutional framework that distinguished "commons" from "property," or from any other institutional arrangement? Any such definition would have to be capacious enough to include both highways and the Spanish irrigation districts, as well as distinguish between them. From the Spanish irrigation districts we take that the absence of the state from the definition of the governance structure is an important component. That is the only plausible marker of systems that include a well-functioning market in private, divisible, tradeable exclusive entitlements like Alicante's water scrip as a "commons." From the roads, we take that it cannot in fact *require* an absence of the state; for roads almost everywhere are provisioned and regulated by the state, and yet are the quintessential case of open commons. If the paradigm case are roads, then the definition will most likely be anchored in a shared element of the three articulations that Hess and Ostrom criticized ten years ago. Lessig emphasized "without the permission of any;" Litman emphasized that "the contents of the public domain may be mined by any member of the public." I underscored the absence of asymmetric decision-making power backed by state power. Because so much more work has been done by Ostrom and others following her work on common property regimes to define CPRs, I will primarily emphasize and try to define and explain this latter form of commons, and only then will return to how it can be unified with CPRs.

Law and legal scholarship are concerned with the organization of the application of state power. Whether one anchors one's understanding in American progressive legal thought or in Weberian sociology, the core question is what characterizes commons in terms of the predictions of when the sheriff will show up, at whose behest, and with what range of options for action.

The core institutional attribute of property *as law*, that is, as a framework for applying the power of the state in its domain of application, is the delegation and allocation to individuals, of calls on the state, to enforce their will with regard to the use, allocation, management, and disposition of resources. In Hohfeldian terms, property is characterized by rights and powers (though obviously entails all the corollaries and opposites he implies). Commons, by contrast, are characterized by Hohfeldian privileges and immunities. In commons freedom to operate outweighs power to appropriate. The main function of commons is to institutionalize freedom to operate, free of the particular risk that an other can deploy the power of the state to deny us use of that resource set, subject to symmetric known constraints and the risk of congestion applicable to that resource set, under those rules, within the expected population of users.

It is critical that we understand this because the question of commons vs. property is not an abstract theoretical problem, but one with immense and continuing significance for material growth and political freedom. As we study various specific commons-based practices, we continue to contribute to a set of ongoing debates over the extent to which nations apply their power to actors and facilities in the global networked environment that will emphasize control and power to appropriate over freedom to operate. As recently as the Spring of 2011, when President Nicolas Sarkozy of France put the networked information economy on the agenda of the G8 for the first time, his core effort was to increase control of the Net for purposes of securing appropriation of the fruits of the music and film industries.[28] In the Summer of 2011, as Congress was playing brinksmanship with the US debt ceiling,

28 NYT story; or something like that.

Republican staffers tried to introduce auction provisions that, had they been law in 1999, WiFi would simply have never developed; had it passed when in fact proposed, this provision would have effectively killed future expansion of the enormously successful spectrum commons of WiFi into its next technological iteration.[29] In part, these examples of blindness to the importance of commons may be a function of the lobbying power of incumbents who benefit from asymmetric power to appropriate. But in part they come from a mindset that persists among global elites that growth and innovation depend on perfecting property rights. The role of the commons in dynamic market economies must be integrated into that basic shared understanding, so that the same global elites will have, in their baseline understanding of how the world functions, an interplay between commons and property, the proper mix of the two institutional frameworks, as their core design goal.

Commons Distinguished; ubiquity thereof

The most important contenders as functioning commons that play a fundamental role in modern market economies are roads and highways, urban sidewalks and squares, and the public domain in information, knowledge, and culture. No capitalist economy functions with the majority of these platforms subject to a property regime or to any common property regime short of a commons: an institutional framework where private parties do not possess asymmetric power to call on the state to back their decisions to exclude, use, dispose, or transfer with legitimate application of its power. The most recent global scale platform with similar characteristics is the Internet Protocol, TCP/IP, which has played a similar role for connectivity and communications and information technologies. On a much lesser, but growing scale, unlicensed wireless is a commons that is coming to play a similar role in constructing the capillaries of Internet connectivity. Recognizing this helps to distinguish commons unmodified from other concepts used in contemporary discussions.

As Carol Rose emphasized in her groundbreaking *Comedy of the Commons*, roads and public squares are the greatest puzzle for the Demsetzian narrative of enclosure following increasing value.[30] In many cases private turnpikes or fields turn through common law doctrines of prescription and fictional grants to open access commons.[31] Henry Smith, as he begins to define a subclass of resource management approachs in *Semicommons*, nevertheless explicitly uses highways as the classic example of a commons, rather than a semicommons, emphasizing that though an occupant of a vehicle has a usufruct-like right in the specific location of her vehicle at any given moment, the dominant aspect of highways are their "commons" aspect.[32] Any other interpretation would be implausible, else one treated an open access pasture as "semicommons" because the cows were private. By contrast to roads, as Hess and Ostrom express quite clearly, "Most of the property systems that are called "common-property" regimes involve participants who are proprietors and have four of the above rights [access,[33] extraction,[34] management,[35] and exclusion[36]], but do not possess the right to sell their management and

29 Spectrum Innovation Act of 2011, discussion draft. http://www.publicknowledge.org/files/docs/DraftHouseRepublicanSpectrumBill.pdf.

30 Demsetz, Fur Trade

31 Rose, *Comedy*, .

32 Smith, Semicommons, at 133-134. But cf. Madison, Frischmann, and Stranburg, Cultural Commons, at __.

33 "The right to enter a defined physical area and enjoy nonsubtractive benefits (for example, hike, canoe, enjoy nature)", *id.*

34 "The right to obtain resource units or products of a resource system (for example, catch fish, divert water) ." *Id.*

35 "The right to regulate internal use patterns and transform the resource by making improvements ". *Id.*

36 "The right to determine who will have access rights and withdrawal rights, and how those rights may be transferred ." *Id.*

exclusion rights even though they most frequently have the right to bequeath it to members of their family and to earn income from the resource. "[37] Highways, sidewalks, and squares clearly provide only the first form of what Ostrom call "rights," and what we in law would properly call "privileges," because they do not entail a call on the power of the state to cause another to permit such access. The Public Domain includes access, certainly, and perhaps "extraction" to the extent that a given use causes a transformation that results in a proprietary right, like copyright or patent, that partly burdens use of the same information or knowledge by another, although does not formally exclude it.

It is possible to get to a common property regime from either a commons baseline or a property baseline. Acheson's classic study of the *Lobster Gangs of Maine* is an instance of formal open access commons (no one may call on the state to exclude anyone else from lobstering)—the legal state of lobster fishing in Maine—turned to common property regime through custom and continuous vigilante violence.[38] By contrast, patent pools are the classic case of a private property regime (owners can call on the state to prohibit infringing products) turned into a common property regime by a set of mutual licenses. This is the class of practices that Jerome Reichman and Paul Uhlir called "contractually reconstructed commons,"[39] and the core of what Madison, Frischmann, and Strandburg called "constructed cultural commons."[40] We can think of contractually reconstructed commons or constructed cultural commons as legal and/or social practices in communities of practice for whom the background legal framework does not provide an adequate or appropriate solution. This may occur because the background law imposes a property regime where a commons would be preferable, given the nature of the resource and needs. Much of the effort on scientific data and open access scholarly publication is of this type. Free software and creative commons are important contemporary instances as well.[41] It may occur because a commons does not fit the nature of the resource or the community of

37 Hess & Ostrom, at 125-126.

38 Acheson, Lobsters.

39 J.H. Reichman and Paul Uhlir, A Contractually Reconstructed Research Commons For Scientific Data in a Highly Protectionist Intellectual Property Environment, 66 Law & Contemporary Probs 315 (2003) (originally presented at the Duke Conference on the Public Domain, 2001).

40 Madison, Frischmann, and Stranburg, *supra*. [add here Kathy's work on pools etc.)

41 Classification of free software, another core example claimed by anyone who wants to claim generality for their version of "the commons," has presented some problems in the past. Clearly, BSD takes property and creates an open access commons. This license is extremely popular and, critically, is the model of the Apache Software License that governs most web-server software in the world, and now governs Android, one of the two major smartphone operating systems. GPL, on the other hand, as well as Creative Commons sharealike licenses, most importantly governing Wikipedia materials, are more challenging. These licenses in no way limit the identity of people licensed to read the materials, or use them as inputs/resources into new production, or to distribute them, including charging for them. In this regard they implement open access commons. They do, however, require modifications that are publicly distributed to come under the same license. They do include, therefore, limits on management and exclusion. Some aspects of free software development projects, notably the process of committing code that can be part of official releases, clearly developed organizational and institutional forms that make them similar to common property regimes. On the other hand, the capacity to take, modify, and use you own version that will not count as "official" replicates characteristics of an open access commons. The difficulty emerges from the double loop. Step 1: the state creates a private property regime by recognizing software as copyrightable. Step 2: developers pre-commit irrevocably to permitting anyone access to their works, and to limit management and exclusion rights from it. Step 3a: Some developers (e.g. Apache Software Foundation) create social institutional practices, not legal devices, which, like the lobster gangs of Maine, create a non-state-based method of management of the most important instance of the work that, while preserving the freedom to operate granted in step 2, denies the management power to the extent it applies to recognition by the community of developers of inclusion in the core code. Step 3b: some developers choose a license that does rely on the power of the state, and is therefore a legal device, to limit extraction rights so that they can only be for personal use. To the extent that extraction is used for software publicly distributed, the extraction right is conditioned on reseeding the commons with whatever improvements one has made. The closest analog from the literature on commons in natural resources are

practice. The lobster gangs of Maine are an obvious example of these. And, as we saw, at the extreme, some structures included under the umbrella of "common property regimes," like the water scrip system of Alicante,[42] are effectively property regimes, classified under the umbrella of the "commons" only because they institute a call on a community's enforcement mechanisms, often one that preexists the modern state in whose jurisdiction it lies, rather than on the state's enforcement powers.[43]

Two terms that incorporate the word "commons" have become highly used, and need to be distinguished here. First, Michael Heller's *anticommons* concept refers to a situation of extreme Coasian inefficiency. Coase's actual theory (as opposed to the misnamed Coase Theorem) states that given transactions costs, markets will fail to move entitlements to their best use; markets move entitlements only to uses whose marginally higher value exceeds present uses by more than the transactions costs associated with shifting. That is why it is important for judges to assign rights to their best use or lower transactions costs: they cannot rely on markets to effect transfers given transactions costs. Heller, observing the bizarre construction of rights in the post-Soviet economies, identified a state in which property rights in critical dependencies lead to stasis. Given sufficient mismatch between the shape of entitlements and the usable packets of resources, and sufficient transactions costs for the recomposition of resources in usable packets, resources will go unused. This then became an excellent model for identifying the problems with patenting of small-scale research tools and gene sequences by Heller and Eisenberg,[44] and what others called, following Carl Shapiro, patent thickets.[45] It is critical to understand that as a matter of legal theory and institutional design, the implication of identifying anticommons problems is not necessarily the introduction of commons or a common-property regime (although it might be). The first and most direct implication is the need to understand the scope and definition of usable units of the resource in question. Then, one may either need to redefine the property rights in question to fit usable units of the covered resource, or to define a commons in the resource, depending on whether it is the type of resource that is best governed by commons or property. But if the answer to a perceived anticommons problem is not obtainable by a redefinition of private property rights around the resource in question, but rather requires instantiation of a commons, like a highway, then the core problem for the resource is not an anticommons problem at all: it is one of misapplying property where commons are the appropriate institutional form.

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state laws that require various preservation measures, such as reseeding oyster beds with cultch, as a use rule applied to an open commons fishery. This can be done in the alternative to Step 3a, as in application of the GPL in smaller projects that have not developed an organizational structure, or cumulatively with Step 3a, as in the Linux kernel development community. What step 3b does is permit access and extraction, but limits management and exclusion to the extent that a developer (a) distributes their output to others and (b) wishes to distribute on terms other than those preserving access and extraction to the next round of users. Because it preserves the symmetric freedom to operate open to anyone that characterizes commons, free software, even GPLed software, cannot be classified as a limited common property regime. No person retains the right to exclude person X, but permit person Y, to make and distribute proprietary modifications, or to determine all management of the resource. Because it depends on the baseline grant of state power of copyright in the software, it is a commons regime carved out of, and with the tools created by, property-like law.

42 Ostrom Governing the Commons, ---.

43 The term "liberal commons" tried to apply the term "commons" to refer to yet a third class of common ownership regimes, including family co-ownership, partnerships, and condominium associations. Hanoch Dagan and Michael Heller, *The Liberal Commons*, 110 Yale L.J. 549 (2001). That effort defined itself in opposition to liberal utilitarianism, overbearing communitarianism (which the authors saw in some of the common property regimes), and anarchic, lawless "open access" commons. *Id.* At 552-553. The effort there was to make commons mainstream by, it seems, stripping the concept of a distinct insitutional core other than common ownership. Below, I try to explain why commons is not defined by common ownership, or by lawlessness, but by absence of ownership defined as asymmetric calls on the state.

44 Heller and Eisenberg *Science.*

45 Carl Shapiro, Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting, in Jaffe, Adam B.; *et al.*. *Innovation Policy and the Economy.* MIT Press 2001.

The second important use of the term "commons" is Smith's *semicommons*. Semicommons, backed out of Smith's study of the open-fields system in England, refers to a situation where the same exact resource is used best for production at different scales. In the case of the fields, wheat growing, which was done on private allocations within the open fields, was a small-scale event; while animal grazing was a large scale event with costs (trampling) and benefits (manure) for wheat growing. A well functioning semicommons divided the individual tracts such that small-scale production was inefficient and free riding or defecting in the common uses was hard. Several papers have tried to analyze policy problems directly applicable to the Net by comparing to semicommons: telecommunications regulation,[46] information production and intellectual property,[47] or the Internet more generally.[48] Of these, the application to intellectual property seems most apt. In particular, it helps understand that debates over the proper scope of intellectual property are never between property and commons, but rather are debates over delineating the boundaries (a) within a semicommons between the private and common aspects (e.g., debates over term of coverage, or the definition of fair use); and (b) between where there is a semicommons, and where there is commons *simpliciter* (e.g., rights in data; status of government publications; future status of academic publishing straddles the two types of debate.) Given that information goods are nonrival, the exclusion of pure property-like systems is unsurprising. Even the efforts of Hollywood and the recording industry to create an effectively perpetual copyright are an instance of debate about where the boundary within a semicommons is located; none of the industry lobbyists are suggesting that scenes-a-faire doctrine be changed to force them to pay owners of standard plot lines a royalty; none are suggesting that Shakespeare's or Dickens's heirs be found to facilitate a market in clearances of rights to make new versions. Finally, the application of semicommons to the Internet generally, based on the private ownership of computers and physical connections to an open network, seems to suffer from the same mistake as treating highways as semicommons would because they are used in private cars. TCP/IP is at its very core a protocol for symmetric, best-efforts clearance of calls on the resources of the network free of any calls on the state to prioritize one person's preferences for clearance over the network over another's. It epitomizes a commons. HTML and the Web similarly do so. Indeed, recent efforts by such bastions of socialism as the *Financial Times* to develop an HTML5-based version for the iPhone and remove Apps from the App store is precisely and instance of organizations leveraging the commons aspect of HTML to get out from a property system applied in a platform context that gave Apple the leverage to demand 30% of every App-based transaction.[49]

Back to Basics: Property vs. Commons in Hohfeldian Terms

Don't roll your eyes! If you think Wesley Hohfeld's century-old characterization of rights, privileges, duties, no-rights, privileges, powers, liabilities, immunities and disabilities are old-fashioned, just think of them functionally. The basic question is whether someone does, or does not, have the legal ability to call upon the power of the state to back their preference for how a given resource will, or will not, be accessed, used, managed, and by whom, or to transfer those calls on the state to others. The terminology is simply a tried and true way of not getting confused about which of

46 Smith, *Governing the Tele-Commons*

47 Heverly, *The Information Semicommons*; Henry E. Smith, *Intellectual Property as Property: An Information Cost Approach*

48 Grimmelman, *The Internet as Semicommons*.

49 FT pulls app over customer data dispute with Apple. BBC, September 1, 2011. http://www.bbc.co.uk/news/business-14734911.

these very real world questions is being asked, what is the answer, and to whom it pertains.

> A has a *right* against B vis-a-vis Use U of Resource R means: A can call on the state to send the Sheriff to make B make or not make U of R.
>
> B has a *duty* to A not to U in R means the same thing: A can call on the Sheriff to stop B from U in R.
>
> If B has a *privilege* to U in R, that means that if A calls the Sheriff to stop B from U in R, the Sheriff will refuse to come. In that case A has *no-right*.
>
> If A can change B's duty or privilege, for example, by selling his right to B so that B no longer has a duty towards A, but has a right as against him, then A has *power* over B's state vis-a-vis U in R. Alienation of property is a *power* in this sense, because it changes the rights, privileges, duties, and privileges of the buyer and seller, as well as the addressee of the duties of any third parties. B is then said to have a *liability* to have B's duties or privileges to U in R altered by A.
>
> If B's legal relations to U in R cannot be changed by A, then B has *immunity* in regard of B's privileges and duties regarding U in R. If B has an immunity, then A is said to have a *disability* with regard to B's U in R.

A property regime instantiates vis-a-vis the resources to which it applies a baseline state where some A or identifiable group A has rights over some class of uses of the resources, which may or may not, but usually do, include powers to change the identity of who occupies the position of A with regard to all or some uses or parts of the resource. Everyone else is usually in the position of B, owing duties and susceptible to liabilities to have their jural relations changed. Markets in property-governed resources are markets in permissions, where buyers buy off sellers to make them selectively remove of the threat to call the Sheriff if the would-be buyer were to make a given use of the stated resource subject to the transaction.

Commons in a resource means that the baseline state is that there is no A or group of A that has asymmetric power to call on the state as above. Instead, the baseline state is that all A have a privilege against anyone else calling the state to prevent them from making use of the resource, and that all A are immune from any B who would like to change that state. B then has no-right, and is under a disability in the Hohfeldian sense that B cannot alter A's privileges.

Note well that a commons so defined does not mean "anything goes." Having rules regulating usage are equally compatible with commons, as long as the core feature of property—the allocation of asymmetric calls on the state among individuals (or to a group of owners) whose use is the subject of markets—is not there. A overly-regulated "commons" will likely fail of its core purpose, because it will undermine the very freedom of action for which commons are useful. A highway on which time, travel path, identity, and load are all regulated by the state fits the definition of "commons" as I classify it here; it is a "commons" that is as misregulated as any property system that defines its property rights poorly enough to make it unusable. A poorly defined property system is not less a property system; so too a poorly designed commons is no less a commons.

The boundaries of "commons" versus "property," when diagnosing real world problems, need

not be marked according to formal law. If by common practice in a given region hunters may cross property boundaries in wooded lands in pursuit of game without asking the owner's permission, and if the local authorities will be very hesitant to respond to a property-owner's call to exclude a "trespasser," then even if the state does not formally recognize this privilege of hunters, we can say that for purposes of hunting during hunting season, the woods are a commons. We would then classify those as a semicommons, to use Smith's term, because they are mostly private property, but have an important and distinct role as hunting grounds that are commons during some significant portion of their use. It is on this understanding that I proposed the functional definition of the public domain as: "the range of uses of information that any person is privileged to make absent individualized facts that make a particular use by a particular person unprivileged.... These definitions add to the legal rules traditionally thought of as the public domain, the range of privileged uses that are "easy cases." [50]

The hallmark of commons, then, as a legal institutional matter, is symmetric freedom to operate vis-a-vis a resource set, generally or with respect to a class of uses "in the commons." The hallmark of property is asymmetric allocation of calls on the state to determine use, exclusion, extraction, management, disposition of the resource or class of uses of a resources. That is why a common property regime is "property" on the outside, vis-a-vis non-members, and commons on the inside—the interventions and usage rules among the common appropriators do not derive from a right to call on the state to exclude any other among them, even if under formal law they do have that right.

Since we all need both freedom to operate and stable reliance on access to and use of resources to plan and execute our plans, and since both property-based markets and commons-based resources have limitations on the extent to which they can offer either, modern capitalist economies are pervaded by both property and commons. A Wall Street trader may wake up in her private property apartment (whatever complications coops and condos present are outweighed by the core private property nature of the apartment), gets out of her private property bed, and goes into her proprietary bathroom. But then she turns on the light. The electricity is provided by either a private company, in New York, or in many other places a publicly-owned utility does so; whether the company is privately or publicly owned, however, public utility law prevents Con-Edison from refusing service to our trader unless she pays a higher amount than her less wealthy neighbors. If she wants to make a toast, the company has no right to prevent her from connecting any toaster she wishes, or advantage her over her neighbors, for a fee, in doing so, as long as the equipment complies with symmetrically imposed safety laws. Even after electricity market deregulation, distribution to homes continues to include a provider of first and last resort, the utility, whose terms of service are regulated and symmetrically available to all. The electric utility cannot offer tiered service to some who are willing to pay more while throttling back use and creating brownouts for those not willing to pay more. Whatever debates there are about proper rates, they do not include the option of rolling brownouts based on willingness and ability to pay. She turns on the tap in her sink, and the water that flows is also a commons. The same applies to the sewage system she uses as the water leaves the sink. She walks out her door, if she lives in Tribeca and walks, she will use the commons that is the sidewalk. If she hops in a taxi, that private business will use the commons called the street. The freedom to operate of the commons assures that she has not only a yellow cab, but can also call any one of a wide range of private carriers, all of whom use the

50 Benkler, Free as the Air to Common Use, 74 NYU L. Rev. 354 at 362. (the omitted text is: "Conversely, The enclosed domain is the range of uses of information as to which someone has an exclusive right, and that no other person may make absent individualized facts that indicate permission from the holder of the right, or otherwise privilege the specific use under the stated facts. "). For a survey of the range of definitions used see Pamela Samuelson, *Enriching Discourse on Public Domains*, 55 Duke L.J. (2006).

commons to take her from A to B without needing to transact to receive permission from an owner of the streets. If she lived in Connecticut and drove in, she would be using I-95 or any of many highways and parkways, all of which are commons, despite the theoretically and occasionally attempted alternatives: private turnpikes, bridges, and ferries. She might take the subway or commuter rail. Again, each is a publicly-provisioned commons-managed system. As she walks into her office building, she relies on its private property for a place to work. She then turns on her private property computer, although it was likely imported over an ocean whose shipping lanes are commons, shipped in a container whose standard size reduced its cost, and is an international commons managed but an international standards-setting organization, and was brought through the Panama Canal which is required by international treaty to allow all peaceful shipping through without discrimination, and denies to the Canal Authority the rights to exclude or manage passage, or to alienate its powers.[51] She might read a proprietary news service, but that news service likely relied in part on facts collected elsewhere, or data generated by the government: these facts are in the public domain and governed as commons, and the newsletter harvests from the commons and bundles into a private product. If she uses the Internet, she may be using a private connection, or a public connection subject to common carriage requirements. Common carriage, in turn, is a set of legal arrangements that assures that a private owner that provisions goods subject to this regime will make them available without discrimination. In other words, while it is a property regime, it is limited property precisely along the dimension of asymmetric exclusion. It functions as a commons. This is true everywhere outside the United States.[52] In the U.S. it was certainly true for DSL services prior to 2005, and arguable true to cable broadband as well. Since 2005, the debates over net neutrality have circled around how much of the nondiscrimination requirement inherent in common carriage to reintroduce after the structural designation was removed. If our trader is using a laptop, chances are it is connected to a Wifi campus network, and WiFi is a commons. The Internet itself, riding on top of the wires or wireless, is a commons, as is the Web to the extent that that is what she uses. If she access any website online, the probability is roughly 3:1 that the Web Server software is an open-access commons governed by the a BSD-like license.[53] Market prices she needs to know are in the commons, although her employer likely pays for privileged early access to the information, and so for an economically-relevant instant they are proprietary and available only to those who buy access. In this regard membership in the stock exchange was historically a club good model of access to instantaneous information on market prices that utilizes physical real property law—the right to exclude from where the board is—to exclude from the real target—market prices—that are, as a matter of law, commons. And so the day goes on. If she makes trades, these depend on the legal system which defines contract and property rights and promises to enforce them. The legal system is available to all on nondiscriminatory terms and no person has the right to exclude anyone else from using it. It is a publicly-provisioned commons.

In personal and commercial life, property is ubiquitous and highly visible to us. What is less visible is that this property system is suspended in commons that undergird and are interpolated

51 Organic Law Panama Canal Authority Section (1997). Article 3, no rights of alienation ("The Canal constitutes an inalienable patrimony of the Panamanian nation; therefore, it may not be sold, assigned, mortgaged, or otherwise encumbered or transferred.") Article 5 requires nondiscriminatory access, ("The fundamental objective of the functions attributable to the Authority is that the Canal always remain open to the peaceful and uninterrupted transit of vessels from all nations of the world, without discrimination, in accordance with the conditions and requirements established in the National Constitution, international treaties, this Law, and the Regulations. Because of the nature of the highly essential international public service provided by the Canal, its operation shall not be interrupted for any reason whatsoever.");

52 Benkler et. Al, Next Generation Connectivity, February 2010.

53 Apache market share most recent number ~65%; nginx another 7%; the license used by Google, at 3%, is unclear.

throughout the proprietary system elements. Perhaps there is a libertarian utopia in which all these functions are subject purely to a proprietary regime. But no actual country in the world, whether it professes to be capitalist or socialist, functions purely on property or purely on commons.

Why are commons so common?

Micro-efficiency under uncertainty and change

Commons and property trade off freedom to operate for security in holdings and power to appropriate. Imagine that John wants to organize a picnic with his friends. He can rely on a commons or on property. Imagine that John has a small back yard in a private home he owns or rents; he can invite people to his backyard. In this case, we can say that he invested in buying (renting) secure (for a period) access to the capacity to invited up to 15 people to an outdoor event in his home. He could also invite them to meet in the park. Then, he runs the risk of not finding exactly the right spot he wants, or congestion if it is a beautiful sunny day in Sheep's Meadow. But he gets the benefit of being able to invite 30 or 50 friends, if that's what he wants. He does not have the security of holdings, but he does have a greater freedom of action with regard to the size of the lawn he can use, and therefore the size of the social network he can engage in this form. Because the park is large and open for all to use, he can be fairly certain that there will be enough room, although he may be uncertain as to its precise quality relative to his yard. If he wants to issue an open invitation for friends of friends to come as well, the freedom-to-operate, in this case to expand the amount of space used on spec, the probability that such space will be available in the park compared to the certainty of an available but potentially cramped space in his back yard begins to be more appealing. Again, if he were planning to charge admission, then the loss of power to appropriate by excluding non-paying participants would outweigh the benefits of flexibility. There, he might choose to expand capacity by renting space from a private party that owns a larger garden. But here again, he runs the risk of either over-investing or under-investing relative to the actual number of participants, which requires that he limit invitations, require clearer RSVPs etc. to avoid overcrowding or unnecessarily expensive over-provisioning. He also runs into transactions costs which may well make contracting too expensive to justify the transaction to begin with. Once he invests and invites people to a private, pre-cleared, secure proprietary location, expanding or contracting capacity through market exchanges, and moving people to the new space, is likely to be difficult. It is trivial in the park.

In a highly uncertain, changing environment, with needs and plans that call for continuously updating the required resources, the freedom to operate provided by commons has important valuable attributes relative to the security in holdings and power to appropriate of property. This tradeoff is far from hypothetical or limited to parties in the park. When presented with major spikes in its network after introduction of the iPhone, AT&T had major congestion problems with its mobile data network.[54] It could have gone to the secondary spectrum markets set up by the FCC a few years earlier to buy more spectrum;[55] where it could have leased the additional capacity in a spot market.[56] It did not. The company went to the commons: it invested in Wifi hotspots and encouraged users to offload traffic to

54 News reports.

55 Secondary market order.

56 Eli Noam, Spectrum Auctions: Yesterday's Heresy, Today's Orthodoxy, Tomorrow's Anachronism, 2 J. L. & Econ. 765 (1998). Noam's vision of a spot market in spectrum replacing auctions of stable long term property rights is most closely implemented by SpectrumBridge, see http://www.spectrumbridge.com/, The Secondary Spectrum Market: A Licensing & Leasing Primer (2008).

their home and public WiFi spots. SFR in France, the second largest mobile provider and third largest home broadband provider, went one further, and harnessed all of its home broadband subscribers, about 22% of the French market, to become WiFi load-balancing points for all their mobile data subscribers. WiFi offloading by carriers has become the norm, carrying anywhere from 20% to 80% of mobile data.[57] The dramatic rate of increase in required data carrying capacity meant that carriers found the commons—WiFi—a more flexible and responsive resource management strategy for spectrum than secondary markets, which are the closest thing to straight property in spectrum that the FCC has ever developed. Even though carriers charge mobile users based on usage, and usage over WiFi connections does not count toward monthly caps and overage charges, the benefits of the flexible deployment and network growth outperformed a more slow-moving, expensive, spectrum property-based approach.

The more diverse and uncertain the needs and plans of users—consumers or producers—are, the more attractive the freedom of action associated with having a resource in the commons is to these users. We can conceptualize it as the commons having a private option value to private users (distinct from its welfare effects), whose price is (a) the reduced certainty of availability of a stated quantity of the resource as available in markets, itself a function of how perfect or imperfect the relevant market is, and how susceptible to failure; (b) the lost appropriation opportunity from not having the resource controlled in a proprietary form; (c) the cost differential between the desired use in the market, given its imperfections (e.g., market power over essential facilities) and the cost of using the commons; and (d) the risk that the commons will be congested. The greater the background uncertainty as to the required quantity or quality of the resource and the market imperfections, the higher the option value—that is, the more of the benefits of property and agent would be willing to forgo in exchange for the greater flexibility offered by commons. The symmetric constraints mean that the need for transactions at the margin is eliminated, and with it transactions cost barriers, strategic behavior for platform or essential facilities, imperfect information with its widespread risk of unmatched offer-ask differences, etc.

Because freedom of action (to adapt to changed circumstances) is every bit as important under conditions of uncertainty as security in holdings (whose value and utility are part of the uncertainty) and power to appropriate outputs (whose coming into being is part of the uncertainty), we need, and find ubiquitously around us, both commons and property. Perhaps with perfectly frictionless markets, under perfect information, we wouldn't need commons. But this is no more relevant than saying that with perfectly selfless individuals under perfect information and frictionless social exchange we wouldn't need property. Given imperfect markets, imperfect information, and diversely motivated individuals, some mix of property and commons is necessary for reasonable planning and pursuit of goals. This is from the *private returns* perspective, setting aside efficiency and growth for a moment. From an individual agent's perspective, having a mix of resources, some commons, some property, will increase their utility over time, given imperfect markets, persistent uncertainty, and change.

Positive Externalities

Over the years, several arguments have been made for when commons are the appropriate institutional framework for a class of resources. In *Comedy of the Commons*, Carol Rose discussed what she called "inherently public property," rather than commons, as the operative concept, but the analysis outlines the foundation of much that followed. These were classes of resources which were to be managed by no one, either private or government, as a proprietor would manage, but rather were, by

57 Reliable estimates are extremely hard to come by, and not necessary for purposes of this theoretical essay.

common law doctrines of prescription or public trust, made public whether or not there was a government action to make them so, or a government manager to provision or manage the resource. Most importantly these applied to roads and waterways. Rose's critical intervention here was triplefold. First, she identified commons as central to the economy, rather than peripheral. Roads and navigable waterways were, in the periods she describes, the central enabler of trade in a growing continental economy. Second, she did not focus on limited common property regimes, or defined classes of users, but specifically on those doctrines that created use privileges for the public at large, and in this really does speak of the commons as symmetric privilege or freedom to operate for an undefined open class, "the public." And third, she identified the role of commons, in particular their positive returns to scale or positive spillovers, as a core enabler of commerce and the core reason to identify relevant commons.[58]

The most complete articulation of an answer to this question to date is Brett Frischmann's work on infrastructure, using the concept of infrastructure capaciously to explore the determinants of when open access, or symmetric access to an undefined public, is the desirable institutional framework.[59] Frischmann begins with nonrivalry and what he calls partial nonrivalry. Nonrival goods, in particular nonrival goods that can be used as inputs into further production, are resources that are particularly important to keep in the commons, to the extent feasible. The most obvious case for this is information, knowledge, and culture, and the importance of the public domain. By partial nonrivalry he means resources that are renewable or cannot be depleted that are subject to potential peak load congestion. These includes highways, lake beaches, the Internet, or wireless communications capacity. I would use partial congestability, rather than partial nonrivalry, for this term, because these are not nonrival goods at all. They are more-or-less renewable goods with substantially variable demand and significant periods of nonscarcity interlaced with periods of congestion. The question for all of these is: how much of the benefits we get from running them as a commons (freedom to operate; positive externalities) we are willing to sacrifice in exchange for more efficient allocation than the model of "first come, first served" over the periods of congestion. The difference between these various resources and Hardin's classic fable is that the commons is not depleted. It is renewable and offers nonscarce resource flows over substantial periods which could be degraded by application of a property regime to solve the less common, but acutely experienced, periods of congestion. Even within this group, there are competing theories about how to attain renewability. Sometimes, as in the case of highways, it will require public investment so as to spread the costs of attaining the positive society-wide effects without requiring the imposition of asymmetric exclusion. Sometimes, it will require a limitation of the degree to which the resources are indeed subject to a commons—as in the case of intellectual property seeking to entice private provisioning of a public good. The precise contours of the tradeoff become the main institutional battleground. Sometimes, as in the case of my own claims about the functioning of unlicensed wireless device markets, the freedom of action generated by shifting the resource (wireless "spectrum") from property to commons will create a market in some other goods (like WiFi devices) that will provide the desired outcome (wireless data carriage).[60]

We could say that resources in modern market economies are usefully managed as commons when:[61]

58 *Id.* at 768.

59 Frischmann, Infrastructure and commons; internet as infrastructure; spillovers with lemley.

60 Overcoming agoraphobia; some economics of wireless.

61 I am primarily synthesizing here from Rose, Comedy, pp.__-__' Frischmann, Infrastructure, __-__; Benkler ___.

(a) efficient allocation of the resource, once provisioned, throughout much of its range of uses, is not a paramount management concern; this includes
    (1) nonrival resources; or
    (2) partially congestable resources, that have variable loads such that over significant ranges of time and usage patterns their use is uncongested;
in both cases the costs of expected congestion in the commons are lower than anticipated for more classically proprietary resources.
(b) significant positive externalities are involved in the social value of the resource set.
(c) the resource is used as input into goods, services, innovations, or other sources of value.
(d) provisioned in a diverse set of market, public, or social processes.

The first characteristic means that the allocation problem of the resource, once provisioned, is either none at all or variable in its intensity so that the good is nonscarce over significant ranges of its relevant usage. The value of instituting a property regime in the resource is then to be found not in its contribution to efficient allocation, but to initial provisioning, if at all. Moreover, the value to the individual of being able to buy secure access to a given flow of the resource is lower where the risk of congestion under a commons framework is lower. The second characteristic suggests that property, to the extent it works to solve either provisioning of a nonrival or partially congestible resource, or allocation problems in congested ranges of uses, involves significant costs in terms of social welfare, because it will limit the positive spillovers from the activities that use the resource. This is most acute in the case of the public domain, but so too would be the social cost of forgone trips if travel were restricted, or if innovations implemented on the Internet would require permission by the private builders of the last mile of connectivity. The third characteristic is a subset of the second, in that it emphasizes the importance of the resource to production in particular. The fourth and final component is the diversity of outputs and modalities of production. The diversity is critical to explaining the importance and function of the symmetry of restrictions and the absence of a gatekeeper who has the right to exclude. Asymmetric exclusion would, at a minimum, bias the productive uses of the resource set toward those whose social value is closest to their private value, with the lowest quotient of positive externalities, and those that tend to be provisioned by market organizations rather than in nonmarket processes. In innovation, the classic commons of the public domain, we see patents, for example, biasing investment toward applicable innovation rather than basic science, which in turn is reflected in, say, pharmaceutical interventions that may or may not have high positive externalities but whose private benefit to the producer is high (follow-on innovations; acne medicine), whereas nonmarket organizations tend to focus on high positive externalities, such as basic science or broad vaccinations with nonpatented vaccines, e.g., measles. The tradeoff between a broad property regime and a narrow public domain, and vice versa, is between these two broad classes of innovation. To generalize, treating critical inputs into production processes as property will tend to favor market-based producers with uses susceptible to well defined appropriation opportunities who can evaluate the monetary value of the input and borrow money to meet the costs of access where they can show a clear appropriation path over producers aiming to produce more remote, or less appropriable (higher positive externalities) outputs, who will be less able to pay the social value of their use.

Between the Huertas and the Public Domain: self-governing commons in the networked environment

The term commons has, over the past twenty years, been used by different scholars, in different scholarly and policy debates, to mark two very different problems that occur at very different scales. In one class of problems, the resource set is highly rival, or subtractable, but the scale of its utilization and

maintenance does not lend itself to efficient allocation into individually-owned units, the number of sustainable appropriators is defined and not too large. Under these circumstances the extensive and careful work of those who have studied CPRs shows us that the binary conception of governance of scarce resources, as either state planning or market mechanisms, is a false binary. Groups of appropriators in resource sets that meet the characteristics of common pool resources have successfully sustained common property regimes that allowed them to exclude others from overusing and congesting the resource, and sustainably sharing its value among them. CPRs are not the only way of appropriating such resources. As Robert Ellickson explained, if the scale of utilization is such that large ownership must be on a large scale, private property is likely to be burdened by transactions costs and inefficiencies relative to common property,[62] but such uses, governed by common law doctrines such as riparian water law and nuisance, have certainly existed and flourished for centuries. Similarly, state-imposed regimes of, say, water drawing rights, or emissions controls and so forth also have wide application. In each of the three cases, local conditions may affect which of these three types of imperfect systems—private property mediated by property, contracts, and torts law, public regulatory law, or formal or informal governance systems among neighbors—will be most productive. As research about prosocial motivations increases, and the range of work, in a broad range of disciplines, that shows that people do sustainably maintain cooperation without either strict monitoring and material interests or perfectly designed material incentives, we can turn increasingly to cooperative regimes to solve problems that states and markets can solve only very imperfectly, as we seem to be doomed to relearn to our detriment every decade. Work on these small to mid-scale collaborative resource governance systems is a critical part of learning how to construct the governance of what is increasingly becoming a viable form of production—social production by distributed, networked collaborators.

We might say that CPRs are most appropriate for resources whose scale of efficient utilization is large but defined. What defines their scope of application is the need to insulate the resource they govern from the population at large. What defines their classification as common property regimes is that the usable resource set is larger than usable by a single household or firm, and that the allocation of the resource is based on a set of rules for use, management, and exclusion whose source is a non-government process, by which the defined set of users governs its collectively-exclusive use of the resource. While often better tailored to historical use patterns of the resource, CPRs are not a flexible institutional form. Even where uncertainty is a major issue, such as with irrigation districts and annual rainfall, the domain and range of uncertainty are reasonably well known, and the range of responses and affected parties well known. The flexibilities in the system allow transaction-free adjustment, but only within well-known bounds. Contrast this with a major shock, such as regional urbanization or a global shift in the location of agricultural production away from the country where the irrigation systems exist, both markets and commons will be substantially more flexible at allocating away from the class of use around which the CPR has developed.

By contrast, open commons are institutional arrangements that cover much larger ranges of resources in modern society, and these resources are generally open to the entire public or at least to some very large, and largely undefined, set of users, both individual and corporate. Their defining feature is not finely-designed allocation of well-behaved and predictable (with known uncertainties) resource sets and needs, but high flexibility and an absence of power of exclusion by early users and uses of the resource against later users or uses. This fluidity comes from their defining institutional

62 Ellickson, Property in Land.

feature—the dominance of privileges and immunities rather than rights and powers; is captured by their core function—creating a freedom to operate available to more or less all actors in the economy they serve; and represents their defining contribution to innovation and trade over time under conditions of persistent uncertainty—that is, to growth. The particular instantiations of the freedom to operate will differ from resource to resource, based on (a) the costs of provisioning the resource and (b) the degree of congestability, and hence the social cost of freedom to operate with the resource expressed as lost capacity at times of congestion, smoothed out over the value of the range of likely congested and uncongested uses over time. Table 1 organizes classic instances of resource utilization along the dimensions of whether they are provisioned publicly or privately, and whether their institutional form is property or commons. The Table helps to explain why the past decade has seen so much overlap between the two concepts of the commons.

* Institutional design * * Provisioning *	Property	Commons
Public	Military bases; European government data	Roads; sewage; urban water systems; public utilities; roads, highways; mass transportation; standards; weather, geo data, etc.; most basic research
Market-based	Hot dog stands; Homes; Land; iPhones; WiFi equipment.	Some public utilities; telecommunications common carrier regimes; unlicensed spectrum capacity
Social	Club-based social networks; Patented academic research outputs	Freely-shared academic research; von Hippel innovation; TCP/IP; the Web; WiFi standards; standards of decency and trust-enabling norms; Wikipedia; Some CPRs; contractually reconstructed commons; culturally constructed commons
Nature	Land; private oyster beds; river water under riparian common law;	Fisheries; some CPRs like pastures; lobsters; Oceans; air.

The rise of networked information economy has led to an increase in the salience and economic role of (a) information production generally, and (b) social production, based on social motivations and organizational models, rather than markets, states, or firms.[63] This has meant that the greatest commons of all, the public domain, has come to play a vastly larger, and more visible, role in the economy as a whole (such as a self-serving industry report claiming that fair use industries account for one sixth of U.S. GDP and 23% of US growth between 2002-2007)[64] at a time when increasing emphasis on market-based model of provisioning everything were obscuring the publicly-provisioned commons from the prevailing model. It has also meant that an increasing amount of goods and services

63 WoN.

64 Thomas Rogers, Andrew Szmosszagi, Capital Trade Incorporated for Computer and Communications Industry Association, *Fair Use in the U.S. Economy: Economic Contribution of Industries Relying on Fair Use*, 2010

from which we derive value continuously falls into the rubric of socially-provisioned, commons-managed resources. Free and open source software was the first major, measurable and economically powerful instance of this trend, and Wikipedia has become the instance that no one can avoid as one of the two central knowledge utilities of first resort (the other being Google, which itself in significant measure is built on harnessing socially-provisioned information alongside state and market-provisioned information). The models of contractual reconstruction of commons—be it in specific, more CPR-like models of closed research communities or patent pools (which fall more in the rubric of privately-provisioned, CPR-managed resources) or in more open access models like Creative Commons have since begun to grow in visibility and importance precisely because the capitalization model—radically decentralized—and organizational model—distributed, have enabled more resources that are important in the networked, global information economy to be provisioned socially. As such, they do not necessarily depend on market-oriented property rights. Indeed, given the extensive work on motivation crowding out, market-oriented property rights applied to socially-provisioned goods and services can be affirmatively counterproductive. Moreover, because they do not need to be provisioned by the state, in the absence of market provisioning, their governance can be self-given. And here is the primary overlap with the literature on CPRs beyond the common intellectual front against the claims of dominance of individual private property, which in terms of intellectual history is the basis of a critical alliance. The commons that we have seen most visibly, and that have become the poster children for the new commons, share this feature of self organization with the classic subjects of the literature on CPRs. Indeed, as in the case of free software and creative commons, they are self-conscious hacks of the state-created system designed carve a commons out of a legal regime intended to foster its opposite: the individual property-like rights of copyright law.

Conclusion

Over the past twenty-five years the study of commons has slowly emerged from under the shadow of the dominant property model. As it has done so, it has developed two distinct arms. The first, more prominent and extensive literature has been the work on common property regimes. This work played an enormously important role in destabilizing the binary, state/market understanding of how production and the utilization of resources can be governed. But its implications for the design of modern, networked, global information economy are relatively narrower than those of the other arm. The less well worked out branch began with the observation that commons—in the forms of waterways and roads—were central in the development of national, trade-based economies. It continued with observations that, as information, knowledge, and culture increased in importance, as innovation became more clearly understood as the central driver of material welfare, and as networked cooperation made social production ubiquitous, symmetrically-privileged freedom to operate is a central aspect of the institutional design of contemporary economies, complementing and completing asymmetrically-allocated rights to control. For many years the alliance between these two lines, in the face of a dominant paradigm, trumped close investigations of the differences. But as recognition of legitimate inquiry into the commons has become mainstream, it is time to place new emphasis on refining our understanding of the very different intellectual and policy agendas implied by these two very different lines of thought. The open commons in particular, the commons of the open road and the public domain, the electric utility and the Internet, is the one that offers the greatest room for work. It is less studied than are CPRs, while its implications reach to the very definition of what constitutes the institutional platform of well-functioning contemporary economies.