Articles

Exchanging Information Without Intellectual Property

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Contracting over information is notoriously difficult. Nearly fifty years ago, Kenneth Arrow articulated a "fundamental paradox" that arises when two parties try to exchange information. To complete such a transaction, the buyer of information must be able to place a value on the information. But once the seller discloses the information, the buyer can take it without paying. The conventional solution to this disclosure paradox is intellectual property. If the information is protected by a patent or a copyright, then the seller can disclose the information free in the knowledge that the buyer can be enjoined against making, using, or selling it without permission. This account of information exchange forms the basis for an increasingly popular argument in favor of strong and broad intellectual property rights for the purpose of overcoming the disclosure paradox and thereby facilitating the development and commercialization of ideas.

That argument, however, rests on assumptions about the nature of information that are neither theoretically nor empirically justified. This Article explains that, contrary to the conventional account of the disclosure paradox, information is not always nonexcludable and is not always a homogeneous asset. Instead, information is complex and multifaceted, subject to some inherent limitations but also manipulable by its holders. These characteristics give rise to a range of strategies for engaging in information exchange, of which intellectual property is only one. Information holders can use the characteristics of information itself as well as contractual and norms-based mechanisms and other legal or business strategies to achieve exchange. And examples drawn from fields as diverse and disparate as software and biotechnology show that entrepreneurs and inventors use these strategies alone or in combination to

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effectively link their ideas with capital and development skills, often without intellectual property appearing to play a significant role in the transaction.

Intellectual property is therefore not necessary to promote robust markets for information and is, in fact, just as contingent and context-specific a solution to the paradox as the alternatives described here. At the very least, then, there is reason to doubt that commercialization theories founded upon information exchange provide a stand-alone justification for intellectual property. This Article urges caution in policy interventions that seek to respond to the disclosure paradox and sets the stage for future empirical research to better understand the dynamics of information-exchange strategies and the social welfare costs and benefits that may accompany them.

Introduction

Contracting over information is notoriously difficult. Fifty years ago, Kenneth Arrow articulated a "fundamental paradox" that arises when two parties try to exchange information.[1] In order to complete such a transaction,

1. Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609, 615 (Nat'l Bureau of Econ. Research ed., 1962).

the buyer of information must be able to place a value on the information and determine how much she is willing to pay.[2] But once the seller discloses the information, the buyer is in possession of the subject of the trade and no longer has any reason to pay for it.[3] This problem has come to be known as the "disclosure paradox" or the "information paradox."[4] The conventional legal solution to the paradox is a grant of intellectual property rights.[5] If information is subject to a patent or a copyright, then it can be disclosed without fear that it will be taken without compensation. Any potential buyer who tries to make, use, or sell the information without permission can be enjoined against doing so through legal process.[6]

This account of information exchange forms the basis for an increasingly popular argument in favor of broad and strong intellectual property rights. That argument proceeds roughly as follows: Exchanging information is critical to innovation because the initial act of creation or invention is only the first step in bringing a product to market.[7] Inventors must usually recruit capital and partners with the skills to develop and then to commercialize their inventions.[8] If the disclosure paradox interferes with entrepreneurs' ability to contract for capital or other resources, and intellectual property solves the disclosure paradox, then the scope of

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2. *Id.*

3. *Id.*

4. *See, e.g.*, Shyamkrishna Balganesh, *"Hot News": The Enduring Myth of Property in News*, 111 COLUM. L. REV. 419, 433 (2011) (describing "Arrow's information paradox" wherein "[a] potential licensee has no way of evaluating the information/intangible until it is disclosed to him; yet, upon such disclosure he has little reason to want to pay for it"); Jonathan M. Barnett, *Intellectual Property as a Law of Organization*, 84 S. CAL. L. REV. 785, 794 (2011) ("Arrow drew attention to this sensitive juncture—postinvention but precommercialization—by describing a dilemma that has since become known as 'Arrow's paradox' or the 'disclosure paradox.'"); Margaret Chon, *Sticky Knowledge and Copyright*, 2011 WIS. L. REV. 177, 198 (noting "the typical assumption of Arrow's information-disclosure paradox: that is, the problem is that knowledge is not easily disclosed"); Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 748 (2012) ("Arrow's Information Paradox suggests that parties may find it difficult to contract to disclose information in the absence of a property right over that information."). Cooter and Edlin refer to the phenomenon as the "double trust dilemma." Robert D. Cooter & Aaron Edlin, *Law and Growth Economics: A Framework for Research* 16 (Berkeley Program in Law & Econ., Working Paper Series, 2011), *available at* http://escholarship.org/uc/item/50t4d0kt.

5. *See, e.g.*, Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 277–78 (1977) ("The patent creates a defined set of legal rights known to both parties at the outset of negotiations. . . . [T]he owner can [therefore] disclose such information protected by the scope of the legal monopoly."); Robert P. Merges, *A Transactional View of Property Rights*, 20 BERKELEY TECH. L.J. 1477, 1485 (2005) (arguing that parties may rely on property rights to solve the problem created by the disclosure paradox because property rights "operate[] effectively even when contracts are difficult to enforce"). Throughout this Article I use the term "intellectual property" to refer to the legal conferral of exclusive rights over information. I exclude from this definition the underlying substance of the information protected by those rights.

6. 17 U.S.C. § 502 (2006); 35 U.S.C. § 283 (2006); eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 391–93 (2006).

7. *See infra* notes 35–41 and accompanying text.

8. *See, e.g.*, Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 348–54 (2010) (providing an example of the commercialization process in the software industry).

intellectual property should expand to encompass whatever information will be socially valuable to exchange. Indeed, although the traditional justification for intellectual property is that it provides necessary incentives for new works of invention or creation,[9] an increasing number of theorists focus on the commercialization of those products as a stand-alone justification for intellectual property.[10]

There can be little doubt that commercialization is of critical importance to innovation and economic growth.[11] Facilitating linkages between creators or inventors and potential sources of development, improvement, and capital is increasingly being recognized as an important policy lever for promoting innovation.[12] But reaching even the narrow conclusion that intellectual property may help join ideas and capital by solving the disclosure paradox in some circumstances requires a more thorough understanding of the disclosure paradox and the range of potential solutions that parties may employ to overcome it than the literature currently offers. This Article explores the paradox and its potential solutions in detail, a necessary first step toward validating both descriptive and normative accounts of the role of intellectual property in information exchange, and it casts doubt on commercialization theory as a stand-alone justification for expanding intellectual property.

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9. *See, e.g.*, Mark A. Lemley, *Ex Ante Versus Ex Post Justifications for Intellectual Property*, 71 U. CHI. L. REV. 129, 129–30 (2004) (drawing a distinction between "traditional economic justification" and "new justifications . . . focus[ed] not on the incentive to create new ideas, but on what happens to those ideas after they have been developed"); *infra* notes 23–28 and accompanying text (citing economics literature).

10. *See, e.g.*, Michael Abramowicz, *The Danger of Underdeveloped Patent Prospects*, 92 CORNELL L. REV. 1065, 1065 (2007) (arguing that current patent law may not protect inventions long enough to make commercialization attractive and proposing an auction system to extend patents to remedy this deficiency); Kitch, *supra* note 5, at 275–80 (justifying "the need for a system of property rights in information" by "a scarcity of resources that may be employed to *use* information" rather than by lack of incentives to *generate* information (emphasis added)); F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697, 705 n.27 (2001) ("This Article offers a view of the patent system that is tied to commercialization, rather than to inventing."); Sichelman, *supra* note 8, at 341 (arguing that traditional patent rights fail to encourage substantial commercialization of inventions and proposing a new "commercialization" patent to rectify this defect).

11. *See* OFFICE OF TECH. ASSESSMENT, U.S. CONG., INNOVATION AND COMMERCIALIZATION OF EMERGING TECHNOLOGIES iii (1995), *available at* http://www.fas.org/ota/reports/9539.pdf ("Technological innovation is essential to the future well-being of the United States. The ability of the nation to sustain economic growth . . . depends, in many ways, on its success in developing and commercializing new products, processes, and services."); Robert Cooter et al., *The Importance of Law in Promoting Innovation and Growth*, *in* RULES FOR GROWTH: PROMOTING INNOVATION AND GROWTH THROUGH LEGAL REFORM 1, 4 (Kauffman Found. ed., 2011) (arguing that research and development spending is not likely to translate into new production and thus economic growth without commercialization); Cooter & Edlin, *supra* note 4, at 14 ("Newly discovered ideas seldom have economic value until they are developed . . . .").

12. Cooter and Edlin, for example, place the development of innovations at the core of their theory of law and growth economics. In their view, "[m]inimizing the double trust problem"—the disclosure paradox—"is central to increasing the pace of innovation." Cooter & Edlin, *supra* note 4, at 17.

More specifically, I demonstrate that the conventional account of the disclosure paradox and its legal solution rests on assumptions that are neither theoretically nor empirically justified. It is based on a stylized model of information that does not reflect the reality of the economic good that parties seek to exchange. And it largely ignores the possibility that alternative mechanisms for facilitating information exchange exist and may present a different social welfare calculus than intellectual property. Drawing on the literatures in management, information science, and law, I develop a framework for evaluating the range of potential solutions to the disclosure paradox and populate that framework with examples of such solutions in operation.[13] I conclude that proponents of a commercialization theory of intellectual property that is focused on the costs of information exchange consistently underappreciate the range of potential strategies by which parties may enable commercially significant exchange and the ways in which those strategies interact within complex business, cultural, and legal environments.[14]

There may be situations where intellectual property is both an effective and the optimal means to facilitate the exchange of valuable information, but there are also circumstances in which either or neither condition will obtain. Intellectual property should be the preferred solution to the disclosure paradox only when it is the best among alternatives. The social welfare costs and benefits of intellectual property must therefore be compared on a case-by-case basis with the costs and benefits of other available solutions. At the very least, our policy discourse ought not to begin with intellectual property as a default rule. Because intellectual property is only one of a number of highly contingent potential solutions to the disclosure paradox, I urge caution

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13. A note on methodology is appropriate here. My argument in this Article is largely theoretical. I draw examples from the existing literature and from a small number of pilot interviews solely to demonstrate that the alternative strategies I describe as a matter of theory actually exist in practice. My examples are offered as "proof of concept" rather than as support for conclusions about the prevalence or frequency with which any particular strategy for exchanging information is employed. That is the subject of my next article.

14. Indeed, most discussion of the paradox in the legal literature is limited to an acknowledgment that it exists and that it may be solved through intellectual property. *See, e.g.*, CRAIG ALLEN NARD, THE LAW OF PATENTS 27 (2008) ("Absent a property right, the inventor will likely be reticent to disclose information for fear of inducing competition."); Oren Bar-Gill & Gideon Parchomovsky, *Law and the Boundaries of Technology-Intensive Firms*, 157 U. PA. L. REV. 1649, 1654 (2009) ("Absent legal protection, the information holder is in a bind: in order to sell the information, she must disclose it to the potential buyer, but once she does, she has nothing left to sell."); Dan L. Burk & Brett H. McDonnell, *The Goldilocks Hypothesis: Balancing Intellectual Property Rights at the Boundary of the Firm*, 2007 U. ILL. L. REV. 575, 585 ("By publicly disclosing technical information, while protecting it by exclusivity, patents circumvent the Arrow paradox."); Paul J. Heald, *A Transaction Costs Theory of Patent Law*, 66 OHIO ST. L.J. 473, 475 n.16 (2005); Christopher S. Yoo, *Copyright and Public Good Economics: A Misunderstood Relation*, 155 U. PA. L. REV. 635, 658 (2007) ("[G]iving follow-on authors a degree of copyright protection offers a solution to Arrow's information paradox."). Jonathan Barnett acknowledges the possibility that other mechanisms exist that may solve the disclosure paradox, but he does not give them significant weight. Barnett, *supra* note 4, at 800–02.

in policy interventions that seek to promote markets in information and set the stage for further empirical research to shed light on when one or another such intervention may be appropriate.

Consider the following example:[15] Biotechnology companies (biotechs) specialize in early-stage research and development of pharmaceuticals. Large-scale clinical testing and manufacturing of pharmaceuticals, however, requires the skills and financial resources of a large pharmaceutical company.[16] It is very common, therefore, for biotechs to seek to license the compounds that they have under development. Information must be exchanged in order for these transactions to take place. The two parties must identify one another as possessing mutually beneficial products or skills. They must then learn enough about one another's products or skills to set the terms of the licensing arrangement.

In these negotiations, a biotech often will approach a potential development and commercialization partner and give an informal presentation about the compound it is developing. In this presentation, the biotech will disclose some data about the compound: the therapeutic area and potential market, the biological targets with which the compound interacts, the compound's pharmacological characteristics, and perhaps some information gleaned from preclinical testing that is relevant to conversations about the potential business opportunity. This presentation is effectively a sales pitch. The biotech will reveal this information to multiple potential partners in search of the right fit. But the biotech will not reveal the chemical structure of the compound itself.

When two companies become interested in pursuing the opportunity further, they will enter into a confidential disclosure agreement (CDA). That agreement typically restricts each party to using the confidential information solely to evaluate whether to enter into a business relationship. With the CDA in place, the parties will engage in further disclosures. The newly disclosed information will include more closely held data about the compound's efficacy or other potential commercial advantages. Yet it will generally still not include the structure of the compound or toxicity data (i.e., information about potential problems).

As the parties move further along in their negotiations, they will sign a "term sheet" that outlines the contours of the potential business deal. They will then engage in significant further disclosures in the course of conducting due diligence. At that point, the biotech will disclose raw efficacy and toxicity data. Even here, there may be some disclosure of the structure, but that disclosure will be only to a limited number of people or a third party

15. This account is drawn from interviews with the CEO and General Counsel of a Boston-area biotech firm, as well as from a review of documentary evidence they provided.

16. For an overview of the pharmaceutical research and development process, see Benjamin N. Roin, *Unpatentable Drugs and the Standards of Patentability*, 87 TEXAS L. REV. 503, 510–11 & nn.21–23 (2009).

"clean team" that will evaluate it independently of the two parties. Finally, when the parties negotiate a contract based on the term sheet, the biotech will disclose the structure of the compound.

This example fundamentally challenges the conventional understanding of the disclosure paradox and the role that intellectual property plays in its resolution. In the classic account, the parties negotiate over the (uncertain) value of the molecule. The biotech must reveal the molecule for the parties to bargain over its commercial worth. But once the biotech discloses the structure, the pharmaceutical company can develop the molecule on its own without paying for it.[17] Intellectual property is therefore thought to be of paramount importance in the pharmaceutical industry.[18] Yet intellectual property is noticeably absent from the story told above, even though the setting represents one of the strongest candidates for conformity to the economic model of the disclosure paradox. That is because although the molecule is covered by a patent, that patent does not effectively protect the molecule at this stage of development. Indeed, in the early stages of pharmaceutical research, competitors may be able to design around any applicable patents. According to the conventional theory, the absence of effective patent protection means that the transaction cannot occur.[19]

But the transaction does occur, for several reasons. First, the biotech can disclose information *about* the compound without revealing the compound itself. That information carries significantly less risk of misappropriation yet is still commercially useful enough to form a basis for bargaining and exchange. Second, the parties rely significantly on reputation effects. Consolidation in the pharmaceutical industry has resulted in a small number of firms that have the capability to do large-scale clinical development and drug marketing. These firms compete heavily with one another for the rights to develop compounds that originate in biotech companies. As a result, their reputations as good-faith negotiating partners are critical to securing future deal flow. Third, these reputational effects are reinforced by formal contracts. CDAs are almost never litigated.[20] Instead, they are used as signals to the reputation market that the relationship between the two companies is becoming deeper. In the pre-CDA interactions, the biotech is responsible for protecting its own sensitive information, and the pharmaceutical company generally does not incur any reputational loss for

17. *See infra* notes 155–58 and accompanying text (describing self-disclosing characteristics of pharmaceutical products).

18. *See, e.g.*, JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 88–89 (2009) ("The canonical example of the free-riding problem is traditional drug development . . . .").

19. *See, e.g.*, Bar-Gill & Parchomovsky, *supra* note 14, at 1654 ("As Kenneth Arrow famously observed, information that is not afforded legal protection cannot be bought or sold on the market.").

20. Indeed, there are serious questions about whether nondisclosure agreements are effectively enforceable at all. *See infra* notes 188–90 and accompanying text.

the use or sharing of information disclosed in such settings. Once a CDA is signed, however, that is a signal that the firms have undertaken a heightened duty of confidentiality to one another, and a pharmaceutical firm that misappropriates information at that stage is likely to suffer reputational harm. The potential for harm is even more serious after a term sheet is signed. And a firm that cheats on a deal after contract is likely to find itself cut off from many future deals. Finally, the entire negotiation takes place against the backdrop of a significant first-mover advantage on the part of the biotech firm. Because drug development is time-consuming and expensive,[21] a biotech company with a head start of several years is at a significant advantage. While it is true that a potential pharmaceutical company partner may be able to appropriate some of the information provided to it in the course of negotiations, as a practical matter that company would be far behind in the development process if it struck out on its own. That commercial reality provides a powerful incentive to deal rather than to defect.

This example and others described in this Article suggest that intellectual property may not be playing the role in facilitating information exchange that the conventional account of the paradox predicts. Indeed, it suggests that intellectual property may be one of several mechanisms that overlap and interact in complex ways. It highlights both the contingency of the intellectual property solution to the paradox and the utility of strategies based on information-flow design, contract, and norms.

To the extent that commercialization theory is founded upon the conventional account of the disclosure paradox, there is reason to doubt that it provides a stand-alone justification for intellectual property. At the very least, the expansion of intellectual property to facilitate exchange is likely to be justified in a far narrower range of circumstances than commercialization theorists predict. Public policy aimed at facilitating robust markets for the exchange of information goods therefore must take full account of the social welfare costs and benefits of all of the various solutions to the paradox.

My argument proceeds as follows. Part I briefly surveys and critiques "commercialization theory," the argument that intellectual property is justified and should be strengthened on the ground that it promotes the development and commercialization of inventions or creations. On one account, this theory is effectively the classic story of incentives to invent just pushed forward in the innovation cycle. Just as intellectual property may be necessary to recoup the costs of invention, so too may it be necessary to recoup the costs of commercialization. But to the extent that commercialization theory aims at a distinct economic function, it is primarily pitched as a solution to the disclosure paradox.[22] Here, the theory suffers

21. Roin, *supra* note 16, at 510–11.

22. *See infra* subpart I(B).

from an overly thin account of the problem it is trying to solve and the solution. Relying primarily on insights from the theory of the firm, commercialization theorists assume that information can be successfully propertized and therefore made into a ready product for exchange. But these insights depend on an insufficiently nuanced theory of information.

Part II begins by examining and complicating two assumptions about information that drive the conventional account of the disclosure paradox. First, information is not always nonexcludable. It has various degrees of opacity that depend in part on its inherent characteristics and in part on how information holders choose to communicate it (or not) to the world. Second, information is not homogeneous. It is not always a stock tip. Instead, it is a multilayered, continuous asset that can simultaneously communicate value in different ways.

These complex characteristics of information give rise themselves to a number of strategies for minimizing or overcoming the disclosure paradox through information-flow design. They also enable a variety of alternative approaches to the paradox. Some are based in intellectual property, while others are based in contracts, in norms of exchange, or in alternative legal or business strategies. The remainder of Part II explains why these solutions to the paradox are theoretically plausible and it offers real-world examples of each to demonstrate that information holders actually utilize them in some circumstances.

Part III draws several implications from this analysis. It argues that intellectual property is not always necessary for the exchange of information and is, in fact, just as contingent and circumstance-specific a solution to the disclosure paradox as the alternatives described in Part II. These solutions each have social welfare costs and benefits that are likely to be similarly situation-specific. Intellectual property is also likely to interact with other mechanisms in complex and overlapping ways. Indeed, if intellectual property works as an overlay on already existing disclosure strategies, then there may be a doubling up of social welfare costs without a concomitant doubling of social benefits. In all events, these tangled consequences suggest that the optimality of any particular policy solution is ultimately an empirical question.

I. The Conventional Account of Intellectual Property and Information Exchange

The traditional economic justification for intellectual property is that it provides needed incentives for the invention or creation of intellectual works.[23] Inventions or creative works require significant investment to

23. *See, e.g.*, Peter S. Menell & Suzanne Scotchmer, *Intellectual Property Law*, *in* 2 HANDBOOK OF LAW AND ECONOMICS 1473, 1476–78 (A. Mitchell Polinsky & Steven Shavell eds., 2007); SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 38 (2004) ("Intellectual property protection gives innovators an incentive to invest in new knowledge."); WILLIAM M. LANDES &

produce. But once they come into existence, they may be copied freely by others.[24] Intellectual property, by "securing for limited [t]imes to [a]uthors and [i]nventors the exclusive [r]ight to their respective [w]ritings and [d]iscoveries," allows inventors or creators to charge supercompetitive prices during the period of exclusivity.[25] The ability to exclude others allows inventors and creators to recoup the costs of their initial investment.[26] In turn, this is thought to create an *ex ante* incentive to engage in the creative work in the first place.[27] In the traditional utilitarian view, then, intellectual property is a policy response to a specific public goods problem.[28]

This incentive, however, entails significant social costs.[29] For one thing, the ability to price intellectual goods above marginal cost results in deadweight loss.[30] This static inefficiency is compounded by a dynamic inefficiency. Because intellectual goods are themselves inputs into further production, exclusion limits the ability of follow-on innovators to create new works.[31] Intellectual property therefore involves a social welfare tradeoff: Society purchases the dynamic benefits of incentives to innovate at the cost of deadweight loss from monopoly pricing and the dynamic inefficiency that results from inhibiting downstream research. The standard incentive thesis suffers from another weakness: There is little empirical evidence that patents

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RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 294–300 (2003) ("The standard rationale of patent law is that it is an efficient method of enabling the benefits of research and development to be internalized, thus promoting innovation and technological progress.").

24. More precisely, information-based goods are thought to be both nonrivalrous and nonexcludable, making them classic public goods. Nonrivalry means that one person's use of a good does not preclude use by any other person. Nonexcludability means that no person can be excluded from using the good. SCOTCHMER, *supra* note 23, at 34.

25. U.S. CONST. art. I, § 8, cl. 8.

26. Menell & Scotchmer, *supra* note 23, at 1478.

27. SCOTCHMER, *supra* note 23, at 38.

28. *See* Menell & Scotchmer, *supra* note 23, at 1476–79 (justifying intellectual property as a solution to the market's inability to incentivize innovation for nonrival public goods like knowledge and creative works).

29. *See* Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEXAS L. REV. 1031, 1058–59 (2005) (describing five types of social costs of intellectual property: "First, intellectual property rights distort markets away from the competitive norm, and therefore create static inefficiencies in the form of deadweight losses. Second, intellectual property rights interfere with the ability of other creators to work, and therefore create dynamic inefficiencies. Third, the prospect of intellectual property rights encourages rent-seeking behavior that is socially wasteful. Fourth, enforcement of intellectual property rights imposes administrative costs. Finally, overinvestment in research and development is itself distortionary.").

30. *Id*. at 1059; *see also* Menell & Scotchmer, *supra* note 23, at 1477; SCOTCHMER, *supra* note 23, at 36–37.

31. Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEXAS L. REV. 989, 996–97 (1997); *see also* Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29, 29–30 (1991) (stating "the cumulative nature of research poses problems" in intellectual property law as patents prevent innovators from building upon the works of others).

provide an incentive for the creation of works that would not have come into existence if the patent system did not exist in the first place.[32]

These problems have led commentators and policy makers to search for alternative bases for the patent system. These efforts are both descriptive and normative in nature. Some seek to explain current features of the patent system; others seek to justify those features or to alter the patent system in ways that are justified by their social welfare effects.[33] Chief among these efforts is an attempt to look past the initial act of invention to ask what effects a system of intellectual property has on subsequent efforts to develop and commercialize that invention.[34]

A. The Commercialization Imperative

Economists since Schumpeter have recognized that there is a difference between "invention" and "innovation."[35] The act of invention or creation is the first step in bringing an intellectual product into the world. Invention is "the act of conceiving the design for a new and non-obvious technological product or process."[36] Innovation, by contrast, is more than the conception of a new idea. It is "the search for and the discovery, development,

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32. Barnett, *supra* note 4, at 793–94 & n.15. Most of the evidence against the incentive theory comes in the form of industry surveys that suggest that innovators do not rely on patents to protect their investments in research and development (R&D). *See, e.g.*, Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development*, 1987 BROOKINGS PAPERS ON ECON. ACTIVITY 783, 796 (relying on survey data to conclude that patents have "limited effectiveness . . . as a means of appropriation"); WESLEY M. COHEN ET AL., PROTECTING THEIR INTELLECTUAL ASSETS: APPROPRIABILITY CONDITIONS AND WHY U.S. MANUFACTURING FIRMS PATENT (OR NOT) (Nat'l Bureau of Econ. Res., Working Paper No. 7552, 2000) ("Based on a survey questionnaire administered to 1478 R&D labs in the U.S. manufacturing sector in 1994, we find that firms typically protect the profits due to invention with a range of mechanisms . . . . Of these mechanisms, however, patents tend to be the least emphasized by firms in the majority of manufacturing industries, and secrecy and lead time tend to be emphasized most heavily."); *Cf.* Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590, 1594 (2011) ("[I]f the innovation would be created and disclosed even without patent protection, denying a patent on the innovation costs society nothing (because the innovation would be developed anyway) and saves society from needlessly suffering the well-known negative consequences of patents . . . .").

33. *See, e.g.*, Barnett, *supra* note 4, at 787 (offering "an alternative account of the patent system . . . that examines how patents influence innovation behavior by influencing organizational behavior"); Clarisa Long, *Patent Signals*, 69 U. CHI. L. REV. 625 (2002) (explaining the social value of patents as mechanisms to signal valuable information); Gideon Parchomovsky & R. Polk Wagner, *Patent Portfolios*, 154 U. PA. L. REV. 1, 1 (2005) (articulating theory of patent value based on aggregation of individual patents).

34. Lemley calls this distinction the difference between *ex ante* and *ex post* incentives, where *ex ante* refers to the incentives that exist before the initial act of creation or invention, and *ex post* refers to the incentives following that act. Lemley, *supra* note 9, at 130.

35. JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 84 (2d ed. 1947); *see also* RICHARD R. NELSON & SIDNEY G. WINTER, AN EVOLUTIONARY THEORY OF ECONOMIC CHANGE 263 (1982); Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1660–61 & n.321 (2003) (following Schumpeter's distinction between invention and innovation).

36. Sichelman, *supra* note 8, at 366.

improvement, adoption and commercialization of new processes, products, and organizational structures and procedures."[37] Invention is the genesis of a new idea. Innovation is the process of bringing that idea to practical life.

There are several ways to describe the multitude of actions that inventors and others must take to bring a new idea to commercial fruition. The process usually requires the inventor first to put the idea into practice—to write a draft, record a demo, design a device, build a prototype. The inventor or creator must then demonstrate its worth. She must then figure out how to produce and distribute the product and determine whether there is a market for it and how to gain access to that market. In one view, the steps comprising "innovation" include identifying a problem to be solved, developing a working prototype, market testing and marketing, distribution, and follow-on improvements.[38]

More generally, innovation can be thought of as comprising three distinct sets of activities: conception, development, and marketing.[39] *Conception* is the discovery of an idea. Ideas rarely have stand-alone economic value. Instead, they gain value when they are *developed*. Development therefore requires resources—capital and skills—to take the bare idea and operationalize it; that is, to determine how the idea will become embodied in a product or a process that has economic value.[40] Finally, those with a product in hand must still bring that product to market. They must produce it for sale, distribute it, and market it.[41]

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37. Thomas M. Jorde & David J. Teece, *Innovation, Cooperation, and Antitrust*, *in* ANTITRUST, INNOVATION, AND COMPETITIVENESS 47, 48 (Thomas M. Jorde & David J. Teece eds., 1992).

38. Sichelman, *supra* note 8, at 348–54.

39. Cooter & Edlin, *supra* note 4, at 14–15; Bar-Gill & Parchomovsky, *supra* note 50, at 398–99. The details of the activities that innovators must undertake to bring their ideas through development and marketing will vary, of course, with the particular industry in which they are working. For several snapshots of the process in different industries, see ASHISH ARORA ET AL., MARKETS FOR TECHNOLOGY: THE ECONOMICS OF INNOVATION AND CORPORATE STRATEGY 45–89 (2001).

40. It is often said that development is the point at which an idea becomes patentable. *See, e.g.*, Bar-Gil & Parchomovsky, *supra* note 33, at 398 (noting that traditional patent law "denie[s] independent property rights in ideas," but "grant[s] full property protection to ideas embedded in inventions"). This view finds support in black-letter patent law that draws a distinction between "conception" and "reduction to practice," where only the latter is patentable. *See, e.g.*, Ariad Pharm., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1352 (Fed. Cir. 2010) (en banc) (noting that actual or constructive reduction to practice, but not mere conception, may be sufficient to satisfy the description requirement of 35 U.S.C. § 112). At the same time, however, a competing and equally longstanding principle of patent law is that the inventor need not create a particular embodiment in order to receive a patent. *See id*. Patent law therefore appears to blur the line between conception and development, at least as those terms are defined as a matter of economic theory above. In the analysis that follows, I take the position that the choice when to protect an innovation as a matter of law is endogenous; that is, intellectual property can attach earlier or later in the process that I describe above.

41. A note on terminology is appropriate here. I shy away from the term "commercialization" in the description of economic functions above because it means different things to different people. To some, commercialization is only the step that I call "marketing." *E.g.*, Bar-Gill & Parchomovsky, *supra* note 33, at 398. To others, commercialization "writ large" includes "any

This process is costly.[42] Each of these activities requires financial resources. In some industries, the cost of development and marketing far outstrips the cost of conception. Partly as a result of these costs (but partly for other reasons) a great many inventions go without commercialization.[43] In such cases, society loses the benefits of invention. Promoting commercialization is therefore an important goal of innovation policy.[44]

Edmund Kitch famously advanced the argument that intellectual property could be used to provide incentives not only for the initial act of creation or invention of an intellectual work, but for the subsequent development of that work as well.[45] Kitch analogizes patents to mining claims.[46] In his view, if a patentee is given broad control over a particular area of technology, the patentee will have the incentive to manage the development of that technology to maximize its social value, just as a private landowner has the incentive to maximize the value of her land.[47] In this way, broad patents give the owner the ability efficiently to "coordinate the search for technological and market enhancement of the patent's value."[48] Kitch also advocates early patenting, which provides the patent holder with the ability to coordinate subsequent development, a point to which I will return in subpart I(B).[49] Although Kitch's argument is primarily concerned with improvements to the original patented technology, it directly addresses the commercialization concern described above. If commercialization is just as expensive and subject to free riding as the initial act of invention, then a broad patent will serve to internalize those costs in the patent holder and allow her to coordinate the development and marketing of the patented invention.

Following Kitch's work, several scholars have advocated more directly for taking the costs of commercialization into account in setting patent policy. Scott Kieff, for example, makes the argument that strong property

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activity following the initial invention that leads to a commercially available product or service—including developing, testing, manufacturing, sales, and service of the initial invention, *as well as* the invention and subsequent development of improvements." Sichelman, *supra* note 8, at 354. I use the term "commercialization" to refer to both the development and marketing functions described above.

42. *See* Sichelman, *supra* note 8, at 371–72 n.184 (remarking that the cost of development and marketing greatly outweighs pre-invention expenses in many industries).

43. *See id.* at 362–65 (surveying empirical data).

44. *See* OFFICE OF TECH. ASSESSMENT, *supra* note 11, at iii (stressing the importance of successful development and commercialization of technological innovations for the future well-being of the United States).

45. Kitch, *supra* note 5. As Kieff points out, concerns about commercialization were voiced during the period leading up to and including the drafting of the 1952 Patent Act. Kieff, *supra* note 10, at 739–44. Kitch's analysis is, however, the pioneering law and economics analysis of the incentives that the patent system may offer to potential developers and marketers of inventions.

46. Kitch, *supra* note 5, at 271–75.

47. *Id.*

48. *Id.* at 276.

49. *Id.* at 271, 277–78; *infra* subpart I(B).

rights are needed "to facilitate investment in the complex, costly, and risky commercialization activities required to turn nascent inventions into new goods and services."[50] Kieff grounds his theory upon the same free-rider problem that plagues the initial development of new technology.[51] Kieff argues that this problem also can hinder the commercialization of that technology.[52] The investment in commercialization may be just as freely appropriable as the investment in the initial invention.[53] His solution is strong, property-rule-based intellectual property. Extending intellectual property rights and protecting them through a strong property rule will ensure that sufficient incentives continue through the commercialization process.[54] Michael Abramowicz similarly addresses the problem of patent "underdevelopment," which he argues occurs "when a patentee decides to abandon a patent that the patentee would have commercialized if longer patent protection were available."[55] Abramowicz focuses on the patent term length and observes that many patents expire before commercialization can take place. His solution, therefore, is to extend the patent term so that exclusivity continues through commercialization and second entrants have less ability to misappropriate the commercialization efforts of first entrants.[56]

Of course, the logic of providing incentives for commercialization can extend beyond the patent system as it currently exists. Ted Sichelman critiques earlier commercialization theorists on the ground that early and broad patenting can bring about suboptimal levels of innovation and commercialization activity.[57] He instead approaches the commercialization problem more directly with a proposal for "commercialization patents" that would operate solely in the post-invention phase of innovation to produce a limited incentive to commercialize.[58] Along similar lines, Abramowicz and Duffy propose a new form of intellectual property protection for "market experimentation"—efforts to determine the size and extent of markets for new products.[59]

Theories of intellectual property that place commercialization rather than invention at their core have been the subject of extensive critiques. Those critiques take two related forms. The first questions whether

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50. Kieff, *supra* note 10, at 703.

51. *Id.* at 708–10.

52. *Id.* at 710.

53. *Id.* at 708–09.

54. *Id.* at 717–27.

55. Abramowicz, *supra* note 10, at 1073.

56. *Id.* at 1071–72. Abramowicz proposes that patent term extensions be doled out via an auction mechanism to limit patentees' incentives to delay commercialization in the hope of gaining an extension of their period of exclusive rights. *Id.*

57. Sichelman, *supra* note 8, at 381–89.

58. *Id.* at 402.

59. Michael Abramowicz & John F. Duffy, *Intellectual Property for Market Experimentation*, 83 N.Y.U. L. REV. 337, 340 (2008).

incentives are really needed for commercialization. Mark Lemley takes this approach. He argues that "ex post" theories of intellectual property are "jarringly counterintuitive in a market economy" because we ordinarily suppose that efficiency in marketing and distribution arises from competition, not from exclusive rights.[60] The second questions whether the additional costs of broadening protection beyond what is necessary for the initial production of an intellectual good are worth the additional social benefits, if any, that accompany expanded intellectual property rights. Merges and Nelson, for example, argue that excessive patent scope leads to *less* development and commercialization and offer a series of case studies as evidence.[61]

Without engaging the broader debate about whether incentives are necessary for more than the initial act of creation or invention, I note that this strand of commercialization theory does not offer an independent justification for intellectual property. To be sure, these commercialization theorists have successfully focused attention on a more nuanced model of the innovation process than that which underlies the classical incentive or reward theory.[62] But they have not identified an economically different function for intellectual property. The theory that commercialization efforts may be freely appropriable by others, and therefore need to be incentivized *ex ante* through a system of exclusive rights, is functionally indistinguishable from the theory that creative or inventive activity may be freely appropriable by others and therefore needs to be incentivized through a system of exclusive rights. In many ways, the "commercialization dilemma"[63] is a version of the same public goods problem that is thought to hamper inventive or creative activity in the first instance. It just occurs later in time. Or, to be more precise, it occurs later in the innovation process.

B. Commercialization and Information Exchange

There is another aspect to post-invention activity, however, that is different economically from the provision of *ex ante* incentives.[64] Development and commercialization not only are expensive, but they also require parties to communicate with one another. After conception, for

60. Lemley, *supra* note 9, at 135; *see also* Lemley, *supra* note 4, at 739–40 ("[W]e don't normally need supracompetitive returns or the prospect of exclusivity just to encourage someone to take an existing invention to market.").

61. *See generally* Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839 (1990); *see also* Lemley, *supra* note 4, at 740–41 (explaining that inventors usually are not the best commercializers for a variety of reasons).

62. *See, e.g.*, Ted Sichelman, *Taking Commercialisation Seriously*, 33 EUR. INTELL. PROP. REV. 200, 200 (2011) (arguing for deeper and more consistent consideration of commercialization in economic and legal analyses of intellectual property).

63. Barnett, *supra* note 4, at 793–94.

64. *See* Tim Wu, *Intellectual Property, Innovation, and Decentralized Decisions*, 92 VA. L. REV. 123, 133 (2006) (noting that reducing transaction costs is a static rather than a dynamic benefit of intellectual property).

example, an inventor who seeks resources and skills for development must convince sources of financing or potential development partners that it is worth their effort to commit resources to the invention. To do this, of course, she must disclose sufficient information about the invention to enable her partners to make a decision regarding their resources. This process repeats itself, on perhaps a different scale and with different actors, once a fully developed invention needs to be marketed.

The disclosure paradox potentially inhibits this communication. An inventor seeking funds or development expertise may be reluctant to disclose information about her invention for fear that the recipients of the information can take it for themselves. On the other side of the transaction, the funders or developers will be unwilling to commit money or resources to the project unless or until they can assess its value. Arrow observed this dynamic and deemed it a "fundamental paradox": the value of information "for the purchaser is not known until he has the information, but then he has in effect acquired it without cost."[65] More recently, Cooter and his collaborators have described this phenomenon as a "double trust dilemma": "To develop an innovation, the innovator must trust the investor not to steal his idea, and the investor must trust the innovator not to steal his capital."[66] The double trust dilemma figures prominently in Cooter's and Edlin's account of the relationship between law and economic growth. They argue that overcoming the dilemma is critical to increasing the pace of innovation, which in turn is a key determinant of economic growth.[67]

Some commercialization theorists recognize this problem and posit intellectual property as a solution. But their accounts of how intellectual property solves the problem are incomplete. The logic of the property rights solution is straightforward enough: The disclosure paradox arises because information is nonexcludable.[68] Once disclosed, it is generally difficult to prevent others from using the information. To the extent that intellectual property makes information excludable[69]—by allowing the holder of a patent or a copyright to seek injunctive and monetary relief against those who would use the information—it provides a mechanism by which an inventor or creator can simultaneously disclose and protect her idea. Arrow himself recognized that "[w]ith suitable legal measures, information may become an appropriable commodity."[70] In somewhat more detail, Merges explains that property rights create "the most effective form of precontractual liability,"[71]

65. Arrow, *supra* note 1, at 615.

66. ROBERT D. COOTER & HANS-BERND SCHÄFER, SOLOMON'S KNOT: HOW LAW CAN END THE POVERTY OF NATIONS 27 (2012).

67. Cooter & Edlin, *supra* note 4, at 13, 17.

68. *See infra* note 105 and accompanying text.

69. I cast doubt upon the ability of intellectual property to ensure perfect excludability of protected information in section II(B)(1), *infra*.

70. Arrow, *supra* note 1, at 615.

71. Merges, *supra* note 5, at 1488.

allowing parties to disclose information that is protected through other (noncontract) legal mechanisms. As Merges explains, property rights in information serve as a "protective cloak" during precontractual negotiations, enabling parties to disclose valuable information while still holding their negotiating partners liable for any attempts to appropriate that information before a contract is completed.[72] If negotiations do fail, infringement actions are available to recover the value of the information disclosed.[73] Kitch similarly invokes the disclosure paradox and observes that a patent can "create[] a defined set of legal rights known to both parties at the outset of negotiations."[74] That is, the disclosure of the invention in the patent instrument itself[75] solves the problem of negotiation in the face of asymmetric information: Both parties know the content of the intellectual good they are bargaining for. With this symmetrical knowledge, the parties can bargain over the "information protected by the scope of the legal monopoly."[76]

Kieff expands on Kitch's argument by allowing for the possibility of coordination among multiple actors rather than by a single rights holder.[77] Kieff posits two mechanisms by which intellectual property can accomplish that coordination. First, intellectual property can serve as a "beacon," "drawing together . . . many complementary users."[78] Kieff explains that the threat of an injunction when intellectual property is protected by a strong property rule facilitates this effect. Threatened with possible injunctive relief, "diverse complementary users of the asset" have an incentive to find each other.[79] Once they do, Kieff posits that a "bargaining effect" facilitates

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72. *Id.* at 1496.

73. Merges cites a second mechanism by which property rights facilitate transactions: They enable information holders to choose from a wider variety of enforcement options should the relationship go awry. This "enforcement flexibility" "enhance[s] the position of property holders when contractual disputes break out" by giving the rights holders a choice of different remedies and different forums. The availability of such a choice increases the confidence of potential information sellers. *Id.* at 1488.

74. Kitch, *supra* note 5, at 278.

75. *See* 35 U.S.C. § 112 (2006) (requiring disclosure of the patented invention).

76. Kitch, *supra* note 5, at 278.

77. *See* F. Scott Kieff, *Coordination, Property, and Intellectual Property: An Unconventional Approach to Anticompetitive Effects and Downstream Access*, 56 EMORY L.J. 327, 328 (2006) (arguing that property rule enforcement can lead to "coordination among entrepreneurs, inventors, and venture capitalists to facilitate commercialization of new ideas").

78. *Id.* at 333–34; *see also infra* note 261 and accompanying text (noting that patents may potentially lower transaction costs by standardizing exchange).

79. *Id*. at 346. Of course, this reasoning requires at least two assumptions about the operation of the patent system. First, that the information disclosed in the patent document is sufficient to inform interested parties that they may want to engage with the patent holder. *But see infra* section II(B)(1). Second, that the information contained in the patent, even if adequate to convey the scope of the invention, is regularly communicated to the potential universe of competitors or collaborators. *But see* BESSEN & MEURER, *supra* note 18, at 54–68 (explaining why and how patents fail to provide adequate notice of the subject matter that they cover).

transactions among those attracted to the patent.[80] The latter effect refers to a solution to the disclosure paradox.[81]

A number of scholars drawing upon insights from the theory of the firm have explained how a grant of property rights in information could facilitate transactions over the protected information. Ronald Coase famously articulated the choice of production structure as being between markets and hierarchies.[82] When transaction costs are low, production can be mediated through freely operating markets and contractual exchange.[83] When, on the other hand, transactions costs become prohibitively high, Coase predicted that firms would develop to bring the production process under the control of a central "hierarchy" free from the vagaries of market exchange.[84] Subsequent work has fleshed out the conditions under which production can be expected to take place through markets or within firms. Oliver Williamson and others have focused on the perils of contracting, noting in particular that it is impossible to write complete contingent contracts—contracts that specify the obligations of the parties in every state of the world.[85] In light of this difficulty, contracting parties often must determine how to minimize the threat that a party will behave opportunistically, attempting to benefit at the expense of the other.[86] Theorists of the firm have developed two approaches to this problem. Economists working in the tradition of transaction cost economics assert that parties can either attempt to erect contractual mechanisms to reduce the threat of opportunism, or they may bring the threat in house by vertically integrating.[87] Others working in the property rights theory tradition have identified a third option—the allocation of residual property rights over the subject of the contract.[88] As Merges describes, "transactors can work around contractual incompleteness by assigning a property right before entering into a contract."[89]

These insights can apply to transactions in information. The disclosure paradox acts as a kind of transaction cost, preventing parties from completing

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80. *Id.* at 334, 346.

81. *Id.* at 414.

82. R.H. Coase, *The Nature of the Firm*, 4 ECONOMICA 386, 387–88 (1937).

83. *Id.* at 390–92.

84. *Id.* at 392–94.

85. OLLIVER E. WILLIAMSON, THE ECONOMIC INSTITUTIONS OF CAPITALISM 30–32 (1985); OLIVER HART, FIRMS, CONTRACTS, AND FINANCIAL STRUCTURE 23–24 (1995).

86. Oliver E. Williamson, *The Economics of Organization: The Transaction Cost Approach*, 87 AM. J. SOC. 548, 554 (1981).

87. *See, e.g.*, WILLIAMSON, *supra* note 85, at 90 (explaining that the degree of "asset specificity" "explain[s] vertical integration"); Benjamin Klein et al., *Vertical Integration, Appropriable Rents, and the Competitive Contracting Process*, 21 J.L. & ECON. 297, 298 (1978) ("Following Coase's framework, this problem [the possibility of opportunistic behavior] can be solved in two possible ways: vertical integration or contracts.").

88. *See* Merges, *supra* note 5, at 1484–85 (citing HART, *supra* note 85, among others who demonstrated that "transactors can work around contractual incompleteness by assigning a property right before entering into a contract").

89. *Id.* at 1485.

market transactions.[90] Parties can minimize the threat that the buyer of information will act opportunistically upon the disclosure of the information he seeks to buy so long as the seller's information is protected through a property right. Several writers posit that intellectual property helps to minimize the transaction costs of interfirm transfers by solving the disclosure paradox.[91] It is a short step from that observation to the argument that where such transfers would be economically efficient but for the presence of transaction costs, intellectual property rights in information that is the subject of exchange promote efficiency.[92]

The theory of the firm suggests that in the absence of other solutions to transaction costs, firms will vertically integrate.[93] By this logic, the absence of property rights in information that firms need to transfer should lead those firms to integrate in order to accomplish the transaction. Arora and Merges demonstrate how strong intellectual property rights "make it possible for technology-intensive inputs to be supplied by separate firms," and therefore "contribute[] to the viability of these specialized firms as standalone entities."[94] Bar-Gill and Parchomovsky similarly argue that intellectual property plays a key role in defining the boundaries of the firm. In their model, nonprotectable innovation will take place within vertically integrated firms, while the advent of legal protection for intellectual property allows firms to achieve gains from trade during the innovative process.[95] Assuming that smaller firms tend to be more dynamic and innovative, the development of such firms may be efficiency-promoting.[96]

This line of argument proposes an alternative economic rationale for intellectual property. It is aimed not at providing incentives for invention or commercialization but at reducing the costs of exchanging critical information. It also supports—sometimes explicitly and sometimes implicitly—the argument that intellectual property should be granted early in the innovation process and should be broad and strong so as to encourage the development of efficient industry structures.

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90. Burk & McDonnell, *supra* note 14, at 587.

91. *Id.* at 587–90; Merges, *supra* note 5, at 1513–19; Heald, *supra* note 14, at 476; Bar-Gill & Parchomovsky, *supra* note 14, at 1653–54.

92. Burk & McDonnell, *supra* note 14, at 613–17; Bar-Gill & Parchomovsky, *supra* note 14, at 1654–55.

93. Coase, *supra* note 82, at 395–97.

94. Ashish Arora & Robert P. Merges, *Specialized Supply Firms, Property Rights and Firm Boundaries*, 13 INDUS. & CORP. CHANGE 451, 452 (2004).

95. Oren Bar-Gill & Gideon Parchomovsky, *Intellectual Property Law and the Boundaries of the Firm* 4 (Harvard Law Sch. John M. Olin Ctr. for Law, Econ. & Bus. Discussion Paper Series, Paper 480, 2004), *available at* http://lsr.nellco.org/harvard_olin/480. Bar-Gill and Parchomovsky assume that trade is not possible absent intellectual property rights. *See id.* at 1 ("[I]nformation that is not afforded legal protection cannot be bought or sold on the market."). In subsequent work, Bar-Gill and Parchomovsky relax this assumption. Bar-Gill & Parchomovsky, *supra* note 14, at 1652. Barnett makes a similar argument that intellectual property rights are determinants of industry structure, which, in turn, determines the efficiency of innovation. Barnett, *supra* note 4, at 790–93.

96. Arora & Merges, *supra* note 94, at 451–52; Barnett, *supra* note 4, at 819–21.

C. Questioning Commercialization Theory

The studies described above identify an economic rationale for intellectual property distinct from both the traditional reward or incentive theory and the incentivize-to-commercialize theory I describe above. Rather than a dynamic benefit to be traded off against static social welfare losses, it is an independent static benefit of intellectual property. That is, by reducing transaction costs, intellectual property can induce the efficient exchange of information goods between purchasers and sellers. If the magnitude of this benefit is significant enough, then it represents a strong argument for the expansion of intellectual property. Indeed, most of the scholars described above advocate for stronger or broader intellectual property protection for the purpose of encouraging transactions in information. Taken to its logical conclusion, this argument suggests that intellectual property should expand backwards into the innovative process, where the problems of information exchange are particularly acute. If Cooter and Edlin are right that the interface between conception and development is the point in the innovation process that is most subject to inhibition by virtue of the disclosure paradox, then intellectual property should protect ideas.[97]

But the writers described above seldom consider the full social welfare costs of their proposals.[98] To be certain, it is difficult to disentangle the various social welfare costs and benefits of intellectual property, especially when a given policy intervention is likely to affect more than one aspect of the calculus. Expanding intellectual property in early-stage inventions because it is thought to overcome the disclosure paradox will also result in changes to intellectual property's incentive effects and to the dynamic social welfare costs described above.

That said, if overcoming the disclosure paradox is to represent a stand-alone justification for intellectual property, it must at least satisfy two tests. First, the policy solution must be addressed toward a problem that is accurately described and of sufficient importance to warrant policy intervention. Second, the intellectual property solution must be the best among alternatives. If there are other, less socially costly, solutions that can be implemented, then, all else being equal, they should be preferred to intellectual property.

The existing literature mostly elides these two standards. Most commentators assume that the conventional account of the disclosure paradox is correct and that intellectual property solves the paradox.[99] In particular, they assume that the economic description of information that

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97. Bar-Gill and Parchomovsky do, in fact, propose a limited entitlement of ideas for the purpose of encouraging a thicker marketplace for the exchange of such ideas. Bar-Gill & Parchomovsky, *supra* note 39, at 397. They do not advocate for outright patent or copyright protection for ideas and acknowledge that such proposals would be too socially costly. *Id.*

98. *See infra* subpart III(A).

99. For a representative sampling of such statements in the literature, *see supra* note 14.

underlies the conventional account is accurate,[100] and they largely fail to consider potential alternative solutions to the paradox other than intellectual property.[101] In the next Part, I complicate each of those assumptions. Doing so reveals that further empirical work is needed before we can state that the conditions for adopting expanded intellectual property as a solution to the disclosure paradox are met.

II. A New Framework for Understanding and Overcoming the Disclosure Paradox

As Part I explained, there is an increasingly popular argument that seeks to justify strong and broad intellectual property rights because of their utility in overcoming the disclosure paradox. But that argument makes several assumptions about the nature of the paradox and its solutions that do not comport with the lived experience of information exchange. This Part therefore takes on those assumptions and demonstrates that they are neither theoretically nor empirically justified. Information is a far more complicated economic good than most commercialization theorists acknowledge. The extent to which the disclosure paradox actually disrupts information exchange depends on just how appropriable the information is. That characteristic—appropriability—is partly inherent in the information and partly manipulable by its holders. This more nuanced understanding of information supports a range of potential strategies for engaging in exchange, of which intellectual property is only one. Yet the existing literature largely discounts the efficacy and prevalence of these alternatives for exchanging information.

A. The Economics of Information Goods

The conventional understanding of the paradox relies on a highly stylized account of information. In particular, it assumes that information is nonexcludable and homogeneous.[102] The former assumption is that once information is revealed, it is impossible to prevent others from using it.[103] The latter assumption is that information is a unitary good; it is revealed or concealed in its entirety.[104] Under these assumptions, the disclosure paradox is easy to explain. Take, for example, a valuable stock tip. Anyone who is exposed to the revealed information can act on it. And the original holder of the information, in choosing whether or not to disclose it, must generally

100. *See infra* subpart II(A).

101. *See infra* subpart II(B).

102. *See, e.g.*, Arrow, *supra* note 1, at 614–15 (assuming that "[t]he cost of transmitting a given body of information is frequently very low" and that "a given piece of information is by definition an indivisible commodity").

103. *See id.* (stating that any purchaser of information "can destroy the monopoly [of the information seller], since he can reproduce the [purchased] information at little or no cost").

104. *Id.* at 615.

disclose the entire tip or none of it at all. Neither of these characteristics, however, accurately reflects the lived experience of information exchange. Instead, excludability is highly variable. It depends on the nature of the information and the parties' choices about how to communicate that information. And information usually is not a unitary good like a stock tip. It is a multilayered asset around which parties can self-consciously structure communications and relationships.

1. Excludability.—Economists and legal scholars often refer to information as either excludable or nonexcludable.[105] But excludability refers more precisely to the *costs* of exclusion.[106] Those costs are not binary. They occupy a spectrum. When the benefit of a good is the *information* conveyed in or about that good, the costs of exclusion actually can be highly variable. The costs of exclusion of information depend in part on the inherent characteristics of that information and in part on choices that information holders can make in shaping the environment in which their information interacts with the world.

Purely nonexcludable information can be imagined as free-floating facts and concepts that can be plucked out of the ether whenever someone encounters them. In this mental picture, the cost of exclusion is infinite.[107] Legal mechanisms are then thought to bring the cost of exclusion down by "fixing" the information in an identifiable *res* through the application of legal entitlements.[108] But information as it exists in the world—and, importantly, as it is exchanged between parties—is not so ethereal as the description above suggests. Instead, information is contained in "artifacts."[109] Sometimes these artifacts are intangible—the information is contained in the

105. *See, e.g.*, Menell & Scotchmer, *supra* note 23, at 1477 ("[I]n its natural state . . . knowledge is . . . 'nonexcludable.' That is, even if someone claims to own the knowledge, it is difficult to exclude others from using it."); Lemley, *supra* note 29, at 1050–51 ("Information is what economists call a pure 'public good,' which means both that its consumption is nonrivalrous . . . and that it is not something from which others can easily be excluded.").

106. *See* RICHARD CORNES & TODD SANDLER, THE THEORY OF EXTERNALITIES, PUBLIC GOODS, AND CLUB GOODS 6 (2d ed. 1996) ("Goods whose benefits can be withheld costlessly by the owner or provider display excludable benefits. Benefits that are available to all once the good is provided are termed nonexcludable.").

107. Inversely, the cost of communication or transmission of the information is zero. *See infra* note 131 and accompanying text.

108. *See* Arrow, *supra* note 1, at 615 ("With suitable legal measures, information may become an appropriable commodity."). Many property theorists also take this approach to conceiving information. *See, e.g.*, Balganesh, *supra* note 2, at 433 ("Two things become central then to the effective functioning of a licensing market: (1) the ex ante characterization of the entitlement as a property right, and (2) the law's attaching it to an identifiable res, albeit a notional one."); Henry E. Smith, *Intellectual Property as Property: Delineating Entitlements in Information*, 116 YALE L.J. 1742, 1755 (2007) (describing intellectual property rights as "a thing to be the object of exclusive rights as against the world").

109. *See* CARLISS Y. BALDWIN & KIM B. CLARK, 1 DESIGN RULES: THE POWER OF MODULARITY 2 (2000) (explaining "artifacts" and design theory's concern with their production). Design theory is largely concerned with the production of artifacts. *Id.*

minds of natural persons, in the operation of organizations, or in the structure of laws or institutions.[110] Sometimes, however, they are quite tangible. Information may be contained in books, drawings, blueprints, computer code, datasets, and products. Different artifacts communicate information in different ways, and at different costs. Take, for example, information about how a simple machine might work. The information can be in the mind of the machine's inventor, where it can only be accessed through interaction with the inventor. He can set it down in a plan or a manual, where it can be accessed by reading. Or he can produce the machine, in which case the information about how it operates may or may not be revealed by inspecting the machine itself.

The excludability of information depends at least in part on the artifact in which it is contained. Patent law scholars have recognized that some inventions are "self-disclosing" or "self-revealing" while others are not.[111] Self-disclosing inventions, in Katherine Strandburg's formulation, allow "competitors . . . immediately [to] appropriate inventive ideas and begin commercial competition almost as soon as an inventor brings a patented product to market."[112] Many mechanical inventions have this characteristic—the paper clip, say, or a particular type of screw or fastener. The value-creating characteristics of the invention are apparent on its face once it is in use in the world. Others therefore can freely appropriate that value once they encounter the invention. Self-disclosing inventions are not limited to mechanical products. Pharmaceutical or chemical products may have this characteristic, as may some business methods.[113] Other inventions are "impossible to discern by evaluating the product," such as the formula for Coca-Cola.[114] Chemical processes that produce particular products may fall into this category as well.[115] Of course, these categories are not binary. There are some inventions from which valuable information may be gleaned with effort—that is, they may be reverse engineered.[116] Software code often has that characteristic.[117] The object code sold to customers does not reveal the source code that would enable duplication, but that latter information

110. *See id.* (outlining intangible artifacts); *see also infra* note 149 and accompanying text (providing an example of an intangible artifact in computer design).

111. Alan Devlin, *The Misunderstood Function of Disclosure in Patent Law*, 23 HARV. J.L. & TECH. 401, 405 (2010); Mark A. Lemley, *The Surprising Virtues of Treating Trade Secrets as IP Rights*, 61 STAN. L. REV. 311, 338–41 (2008); Katherine J. Strandburg, *What Does the Public Get? Experimental Use and the Patent Bargain*, 2004 WIS. L. REV. 81, 104–18.

112. Strandburg, *supra* note 111, at 105.

113. *Id.*

114. Lemley, *supra* note 111, at 338.

115. *Id.* at 338–39.

116. *See* Pamela Samuelson & Suzanne Scotchmer, *The Law and Economics of Reverse Engineering*, 111 YALE L.J. 1575, 1582–91 (2002) (describing legal and economic perspectives on reverse engineering).

117. Lemley, *supra* note 111, at 339.

sometimes can be gleaned through reverse engineering.[118] In all events, the cost of exclusion depends in no small part on the manner in which information may be accessed from the artifacts that contain it.

The same reasoning applies to information contained in intangible artifacts. Economics and management scholars have long recognized that some knowledge is to be found not in transferable artifacts, but in persons.[119] Most broadly, this "tacit knowledge" is information that has not been set down or codified.[120] More specifically, the term sometimes applies to information that is costly, difficult, or impossible to codify. In this narrower sense, tacit knowledge is perhaps more accurately described as "know-how."[121] To return to the example of the simple machine above, when the knowledge about how to work the machine resides solely in the mind of the inventor, it is "tacit" in the sense that it is uncodified. Should the inventor write an instruction manual, he would convert some of his tacit knowledge to articulated or codified knowledge. But there is perhaps some aspect of the machine's working that is impossible to articulate; that is the accumulated "complex set of knowledge bases, competencies, and skills"[122] that a person with expertise in a particular art comes to possess over time. Regardless of the precise definition of tacit knowledge, which can at times be elusive,[123] the important point is that tacit knowledge is at least partially excludable. Tacit knowledge, as Eric von Hippel notes, is "sticky"—it is "costly to acquire, transfer, and use."[124] Sticky information can be transferred only if the costs of codification are incurred or if the person in possession of the information engages in social interaction with others who might want to acquire and use the information.[125]

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118. *Id.*

119. Michael Polanyi is widely credited with first articulating this concept of "tacit knowledge" in THE TACIT DIMENSION (1966). Nelson and Winter extend the concept to include knowledge contained not only in individuals, but also in organizations. NELSON & WINTER, *supra* note 35, at 76, 115–17.

120. Ashish Arora, *Contracting for Tacit Knowledge: The Provision of Technical Services in Technology Licensing Contracts*, 50 J. DEV. ECON. 233, 234 (1996) ("As the name suggests, tacit knowledge represents those components of technology that are not codified into blueprints, manuals, patents and the like."); *see also* ARORA ET AL., *supra* note 39, at 95 (citing distinction between "tacit and codified dimensions of knowledge").

121. Ashish Arora, *Licensing Tacit Knowledge: Intellectual Property Rights and the Market for Know-How*, 4 ECON. INNOVATION & NEW TECH. 41, 42–43 (1995); Chon, *supra* note 4, at 187.

122. ARORA ET AL., *supra* note 39, at 95.

123. *See* Robin Cowan et al., *The Explicit Economics of Knowledge Codification and Tacitness*, 9 INDUS. & CORP. CHANGE 211, 211–13 (2000) (describing a "considerable amount of semantic and taxonomic confusion" associated with "tacit knowledge").

124. Eric von Hippel, *"Sticky Information" and the Locus of Problem Solving: Implications for Innovation*, 40 MGMT. SCI. 429, 429 (1994).

125. A separate branch of the literature addresses the social rather than economic dimension of tacit knowledge. *See, e.g.*, HARRY COLLINS, TACIT AND EXPLICIT KNOWLEDGE 11 (2010) (describing knowledge that requires individual social relationships or immersion in society to transfer); Chon, *supra* note 4, at 191–95 (describing both interpersonal and cultural aspects of knowledge transmission).

Generalizing from these observations—that information can be contained in artifacts, including individuals and organizations, that have different excludability characteristics—Sidney Winter articulates a taxonomy of information goods.[126] Winter writes that information goods can be classified along six dimensions: tacit and articulable; not teachable and teachable; not articulated and articulated; not observable in use and observable in use; complex and simple; and elements of a system and independent.[127] In this taxonomy, each attribute pair represents two poles. Information that lies closer to the pole represented by the first description above is harder or costlier to transfer; information that lies closer to the opposite pole is easier or less costly to transfer.[128] Each pairing represents a continuum.[129] Information may be easier or harder to transfer depending on where on each of the continuums the information lies.

It is worth pausing for a moment to return to the disclosure paradox. Recall that in Arrow's model, information is perfectly nonexcludable.[130] At the very least, the foregoing discussion demonstrates that this is not an accurate assumption to make. Information may be partially excludable, depending on the form that it takes as it exists in the world. This means that the costs of communicating that information are not always zero.[131] Misappropriation of information therefore does not happen automatically upon exposure. Instead, nonzero communication costs mean that the disclosure paradox will not operate in all circumstances as the conventional account suggests. A potential development partner or venture capitalist who is shown a prototype of a device may not be able to determine from inspection how the device works. Some information may be transferred—information about what the device is or what it does; but other information will not necessarily be appropriated by the potential buyer—information about how to replicate the device and make it work. So long as the value of the latter is higher than the value of the former, disclosure by a seller of some information to a buyer does not imply that the buyer "has in effect acquired [the information] without cost."[132]

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126. Sidney G. Winter, *Knowledge and Competence as Strategic Assets*, *in* THE COMPETITIVE CHALLENGE: STRATEGIES FOR INDUSTRIAL INNOVATION AND RENEWAL 159, 170–73 (David J. Teece ed., 1987).

127. *Id.*

128. *Id.*

129. *Id.*; *see also* Cristiano Antonelli, *The Business Governance of Localized Knowledge: An Information Economics Approach for the Economics of Knowledge*, 13 INDUS. & INNOVATION 227, 229–31, 237 tbl.1 (2006) (articulating an alternative framework).

130. Arrow, *supra* note 1, at 615.

131. *See* James Bessen, *From Knowledge to Ideas: The Two Faces of Innovation* 3 (Boston Univ. Sch. of Law Working Paper No. 10-35, 2012), *available at* http://www.bu.edu/law/faculty/scholarship/workingpapers/2010.html (arguing that communication costs fluctuate depending on economic factors).

132. Arrow, *supra* note 1, at 615.

Biotechnology companies often take advantage of the difficulty in transferring sticky knowledge in the early stages of negotiations for early-stage platform technologies. These are technologies that are primarily used as research tools.[133] When such technologies are in the early stages of development, they are typically not yet the subject of patent protection. But their development often requires partnerships or infusions of capital. Because they are research tools, some aspects of their effective use are tacit. The scientists who work with the tools know how to use and optimize them. As one biotech entrepreneur explained, he allows potential development or financial partners free access to his labs. These partners can see the technology in operation yet cannot use or replicate it themselves without the tacit knowledge of its developers. But the lab tours offer enough information about the invention to at least determine mutual interest. The parties then can negotiate for the transfer of the tacit knowledge.[134]

In addition to assuming that the costs of communication are zero, Arrow's model also assumes that communication costs are exogenously fixed.[135] It is certainly true that some aspects of information goods are likely to be inherent in the goods.[136] Highly "tacit" information in Winter's taxonomy, for instance, is simply not capable of being "articulated" in symbols. (Though it may be transferable by teaching.)[137] Similarly, in the realm of tangible artifacts, information may be capable of embodiment in certain artifacts but not in others.

But the fact that some aspects of the informational content of a good may be unchangeable does not justify an assumption that *all* information characteristics of a good are immutable. Winter was among the first to point out that the structure of information is the result of economic choices that those in possession of the information can make.[138] It is often an endogenous choice. As Winter puts it, "The degree of articulation of anything that is articulable is partially controllable."[139] At times, information holders can

133. *See* Douglas Lichtman, *Property Rights in Emerging Platform Technologies*, 29 J. LEGAL STUD. 615, 615 & n.1 (2000) (describing and defining "platform technology").

134. *Cf.* Chon, *supra* note 4, at 196 ("The stickiness of such knowledge is something that can be used in a deliberate way to ensure that it is not diffused or that it is diffused only under controlled conditions such as the licensing of inventions.").

135. *See* Bessen, *supra* note 131, at 3 (noting Arrow's model assumed "exogenously low communication costs").

136. *See* Winter, *supra* note 126, at 174 ("[I]ntrinsic differences among knowledge bases and other circumstances of different areas of technology and organization are important determinants of where newly developed assets tend to fall along the taxonomic dimensions identified above."); Chon, *supra* note 4, at 189 (differentiating between tacit knowledge by choice and tacit knowledge due to communication costs).

137. *See* Winter, *supra* note 126, at 171–72.

138. *See id.* at 174 ("There do exist important opportunities for affecting the positions that particular knowledge development take on these dimensions."); ARORA ET AL., *supra* note 39, at 96 ("[T]he extent to which knowledge is codified, or more generally, the extent to which it is easy to transfer, is an economic decision rather than an inherent property of knowledge.").

139. Winter, *supra* note 126, at 174.

choose to articulate or codify their information or not. Similarly, information holders can choose to embody their information goods in self-disclosing artifacts or not. These choices of course impact the extent to which information can be transferred.

A small literature in both economics and law has attempted to understand the nature of the choice to make information more or less transferable.[140] It starts from the premise that converting less transferable knowledge to a more transferable form—for instance, codifying previously tacit knowledge—is costly.[141] It requires developing a means to codify the information—to convert it from knowledge contained in individuals' minds to knowledge communicable through artifacts, and then actually doing so.[142] The economic question, then, is under what circumstances might a firm undertake to incur the costs of making knowledge more transferable. Winter posits that a firm will do so when the benefits of voluntary transfers outweigh the potential costs of involuntary transfers; that is, when it is more beneficial to a firm to be able to engage in information exchange than to guard against misappropriation.[143] Bessen models the decision to formalize knowledge where the costs of doing so are nonzero in a variety of circumstances, and finds that "it does not pay to formalize knowledge unless the market is sufficiently large to recoup formalization costs."[144]

This literature takes the stickiness of knowledge as an impediment to transfer that must be overcome in order for contracting over knowledge to occur. There are two complicating factors, however, that shed further light on the nature of the disclosure paradox: First, information holders do not face a binary choice to codify their information or not. Instead, the range of options available to information holders is much wider. The decision whether or not to *codify* information is really a decision about how to *structure* information. Consider, for example, the concept of "modularity" that is often invoked in software design (and in design theory more broadly). Modularity is a design principle that seeks to decompose a complex system into parts—or "modules"—that are highly independent yet can work together.[145] An architect designing a complex system achieves modularity in part by drawing a sharp distinction between visible information and hidden

140. *See, e.g.*, ARORA ET AL., *supra* note 39; Bessen, *supra* note 131; Dan L. Burk, *The Role of Patent Law in Knowledge Codification*, 23 BERKELEY TECH. L.J. 1009, 1012–17 (2008); Cowan et al., *supra* note 123; Winter, *supra* note 126.

141. *See* Bessen, *supra* note 131, at 9–14 (detailing the costs of communicating technical knowledge); Burk, *supra* note 140, at 1013–16 (discussing the costs associated with the codification of knowledge).

142. *See* Burk, *supra* note 140, at 1013–14 (discussing the costs involved in creating and implementing a scheme to codify information); Cowan et al., *supra* note 123, at 247–48 (explaining the ways in which codification of knowledge can sometimes decrease its communicability).

143. Winter, *supra* note 126, at 173–80.

144. Bessen, *supra* note 131, at 3.

145. *See* BALDWIN & CLARK, *supra* note 109, at 63 (defining modularity); Smith, *supra* note 108, at 1761–63 (explaining the utility of modularity in dealing with complex systems).

information.[146] Only the visible information is required for the modules to cooperate.[147] Information specific to the workings of the module itself can remain hidden from the other modules.[148] The designer of a computer operating system, for example, can keep most of the details of the system's internal processes secret, while revealing to the world the set of commands that allow programs to interface with it.[149] Similarly, information holders can design the artifacts that embody their information to make some aspects excludable and other aspects freely available.

Second, the conventional account of the disclosure paradox suggests that there is a one-to-one correspondence between the decision to codify and the decision to transfer. Winter writes that "[f]eatures that restrain involuntary transfer tend to inhibit voluntary transfer; likewise, actions undertaken to facilitate voluntary transfer may well facilitate involuntary transfer also."[150] Likewise, the literature modeling the economic choice to codify information assumes that the choice to codify is made when the possessor of the information wants to transfer it.[151] But once the choice of information structure is understood not to be binary, the relationship between information structure and transfer becomes more complicated.

The impediment to transfer that the disclosure paradox describes is not cost. It is appropriability. The paradox suggests that parties will be unable to transfer information when it is in a form that renders it freely appropriable by others. What is needed, therefore, is some kind of *optimum* level of appropriability that allows for (a) sufficient information to be transferred to link ideas with capital and development partners while (b) ensuring that enough value remains in the original information holder so that she still has an incentive to disclose.

This theoretical optimum can be achieved through the use of nonbinary information management techniques described above. Most simply, parties can engage in selective disclosure. If parties are able to partition their information so as to reveal some but not all of the relevant information to counterparties, then it is possible to facilitate exchange while simultaneously guarding against misappropriation. But the discussion above suggests that parties can manipulate not only the plain amount of information that they reveal to others, but also the form that their information takes. Biotech companies thus choose to leave certain information tacit not to keep it to themselves, but actually to facilitate transfer by overcoming the disclosure

146. *See* BALDWIN & CLARK, *supra* note 109, at 72–76.

147. *Id.* at 73.

148. *Id.*

149. *See, e.g.*, United States v. Microsoft Corp., 253 F.3d 34, 53 (D.C. Cir. 2001) (explaining operation of "Application Program Interfaces" or "APIs" that expose some but not all software operating routines to potential developers).

150. Winter, *supra* note 126, at 174.

151. *See, e.g.*, Arora, *supra* note 121; Bessen, *supra* note 131.

paradox.[152] Software developers use modularity to shield some information from potential partners so that they can overcome the disclosure paradox and engage in constructive transfers of commercially valuable information. In each of these examples, the information holder relies upon the partial excludability of information and the ability to manipulate the information content of the artifacts at her disposal to achieve *some* level of disclosure and some level of forbearance. It is not always the case that decisions to make information less transferable will induce less transfer. Instead, utilizing relatively less transferable forms of artifacts that nevertheless convey sufficient information to enable exchange actually can induce *more* transfer by overcoming the disclosure paradox.

As the discussion above indicates, the excludability characteristics of information are far from binary. This means that the disclosure paradox does not always prevent the successful sharing of an information good. The good may itself be partially excludable, allowing the potential buyer to access enough information to estimate its worth while allowing the seller to retain sufficient value; or the information holder can design the information-conveyance mechanism in such a way as to enable disclosure while guarding against misappropriation.

2. Heterogeneity.—The conventional account of the disclosure paradox conceives of information as a homogeneous asset.[153] In this view, information is discrete. It is singular. It is the stock tip described above, which the holder either knows or not, can act upon or not, and can disclose or not.[154] But very little information has the characteristics of a stock tip. More often, information is multilayered and continuous. More particularly, different types of information about a particular intellectual product may be relevant in different circumstances and contexts of exchange. Information is heterogeneous.

This phenomenon is perhaps best illustrated by the example of small-molecule pharmaceutical development described above.[155] Most drugs are single compounds.[156] A single compound corresponds to a single product. The structure of the compound is the critical information behind the product—it defines the product's pharmacological properties. The structure also is highly self-revealing.[157] Once a drawing or chemical formula that

152. *See supra* notes 133–34 and accompanying text.

153. *See, e.g.*, Arrow, *supra* note 1, at 615 (noting that information is "indivisible").

154. *See supra* subpart II(A).

155. *See supra* text accompanying notes 15–20.

156. Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1590, 1617 (2003).

157. It is true that most pharmaceutical compounds are protected by patents. But patents provide only incomplete protection from competitive misappropriation. This is particularly true during negotiations between small biotechs and large pharmaceutical companies. Because these negotiations take place in the preclinical or early-stage clinical phases of pharmaceutical testing, it

reveals the structure of the compound is shown to potential partners, those partners know all they need to know to reproduce the pharmaceutical.[158] The disclosure paradox should operate according to Arrow's model in this circumstance to block even the initial contact between the biotech that is developing the compound and the pharmaceutical company with which it seeks a partnership for development and commercialization. But while the structure is of course the driver of value in the market for approved pharmaceuticals, its disclosure may not be necessary to assess its value as an input into development and commercialization processes. Instead, at the licensing stage, the most commercially relevant information might be data *about* the compound: its efficacy, its pharmacological characteristics, and so forth. Commercially useful information short of the core intellectual asset may thus be disclosed in the course of a negotiation. Indeed, in the pharmaceutical example, the negotiation may be all but completed by the time the structure is revealed.[159]

A similar phenomenon can be observed between software innovators and potential sources of funding.[160] The core intellectual asset that a software developer has is her code.[161] But she need not disclose the code to convey commercially relevant information to potential funders. Instead, the early meetings between entrepreneurs and investors focus on what the software can do, what the potential underserved need might be, what the competitive landscape for the application might be, and similar questions. That information enables potential funders and partners to evaluate the business opportunity without appropriating the core information asset. Only later in the negotiation will the code be revealed.

As a practical matter, then, both biotechnology and software entrepreneurs will begin discussions with potential investors and partners by revealing information *about* their product or idea, but not the structure of the product or the details of the idea itself.[162] They are able to do this because

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is possible for a large pharmaceutical company that has access to the structure of a promising compound to innovate around the patent protecting that compound. *See infra* notes 171–75 and accompanying text.

158. That knowledge does not, however, guarantee that a potential competitor could complete testing, Food and Drug Administration (FDA) approval, and marketing of the compound first. The seller here therefore retains some first-mover advantage, which may itself be a means to guard against misappropriation. *See infra* notes 240–41 and accompanying text.

159. *See supra* text accompanying notes 15–20.

160. This example is drawn from interviews with several Boston-area entrepreneurs and venture capital investors.

161. Like the pharmaceutical molecules described above, software code may be subject to formal intellectual property protection, but that protection is inevitably incomplete. Most source code is copyrighted, but it is often a relatively straightforward task to produce similar functionality using code that is not directly copied from the copyright holder.

162. A similar illustration of the multifaceted nature of information can be seen in the literature on "patent-paper pairs," which seeks to explain why scientists reveal information about a research project simultaneously in academic publications and patent applications. The explanation turns on the fact that scientific research produces both academically useful and commercially useful

information is multilayered. To generalize from the examples above, imagine a series of concentric circles. In the innermost circle lies the "core" information asset. The definition of the core asset depends on the particular technological and business context. One can reasonably posit, however, that it is at least the asset that the holder would be most fearful of releasing to the public. Most likely, this is because it represents the bulk of the value to the holder. To the pharmaceutical company, the structure of the molecule it is developing into a drug is the core information asset. To a software developer, it may be the code for the software.[163]

Beyond this core lies "second-order" information that can be used to describe some relevant characteristics of the asset.[164] This information is directly related to the characteristics of the core asset. In the case of the pharmaceutical molecule, it may refer to the molecule's physical characteristics other than its structure: its pharmacological properties, the diseases that it targets, and so forth. In the case of software code, this direct information may include what the code does or a description of its operation at a somewhat higher level of abstraction. Beyond this second-order information lies other higher-order information. The further one gets from the core, the more attenuated this information becomes. In the pharmaceutical example, this higher-order information may be the data about the drug's performance in preclinical testing; in software, it may be information about the market opportunity. But even highly attenuated information still conveys knowledge about the core asset.

In this way, entrepreneurs can design their information flows to enable meaningful commercial exchange without revealing the core information

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information, and that the two types of information can often be separated from one another. Joshua S. Gans et al., Contracting Over the Disclosure of Scientific Knowledge: Intellectual Property and Academic Publication 4 (Apr. 8, 2011) (unpublished manuscript), *available at* http://ssrn.com/abstract=1559871.

163. It is important to note here the contingency of the word "may." It is also possible that there are other sources of value for a software developer that ultimately are more important than the code. *See infra* note 243 and accompanying text.

164. This taxonomy bears some resemblance to that in R. Polk Wagner, *Information Wants to Be Free: Intellectual Property and the Mythologies of Control*, 103 COLUM. L. REV. 995, 1003–10 (2003). It is, however, different in both concept and purpose. Wagner articulates three types of information that vary primarily in their appropriability: Type I, which is protected by intellectual property; Type II, which comprises directly related works or improvements; and Type III, which represents spillovers or generative information related to the intellectual property. Wagner is concerned, however, with appropriability as a matter of positive law, while my concern is with the communicability of commercially useful information. Closer perhaps is the concept of information spillovers described in Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257 (2007). Finally, this concept is similar to the problem—common to both copyright and patent law—of identifying the correct "level of abstraction" to define the scope of information to be protected by an exclusive right. *See* BRETT M. FRISCHMANN, INFRASTRUCTURE: THE SOCIAL VALUE OF SHARED RESOURCES 288–92 (2012) (discussing the difficulty in drawing a line between idea and expression); Tun-Jen Chiang, *The Levels of Abstraction Problem in Patent Law*, 105 NW. U. L. REV. 1097, 1100–01 (2011) (describing how patent scope varies with the level of abstraction of description).

asset. This is true even when that asset is highly self-revealing. The information holder who is unable to rely on inherent or designed excludability may nonetheless still engage in exchange of information *about* her information.

B. Alternative Solutions to the Disclosure Paradox

The discussion above suggests that parties seeking to exchange information may in some cases rely upon characteristics of the information itself to accomplish transactions or, perhaps more frequently, can design their information flows in such a way as to enable commercially meaningful communication while simultaneously guarding against misappropriation. The nature of information itself therefore gives rise to strategies for overcoming the disclosure paradox that are based on manipulating information flows. The characteristics of information described above complicate the intellectual property solution and also enable a series of strategies that are routinely overlooked or dismissed in the existing literature.

1. Intellectual Property.—As Merges and others have observed, intellectual property may in certain circumstances play a role in overcoming the disclosure paradox.[165] But positive law intellectual property regimes have limitations. While intellectual property may facilitate disclosure in some circumstances, it may be inadequate in others. Understanding the complex nature of information helps to determine circumstances in which intellectual property may or may not help to overcome the disclosure paradox.

The basic logic of the disclosure paradox suggests that legal intervention is necessary for otherwise freely appropriable information to become less appropriable and therefore subject to exchange.[166] Arrow understood, however, that these legal measures were necessarily limited: "[N]o amount of legal protection," he wrote just a paragraph before explaining the disclosure paradox, "can make a thoroughly appropriable commodity of something so intangible as information. . . . Legally imposed property rights can provide only a partial barrier, since there are obviously enormous difficulties in defining in any sharp way an item of information and differentiating it from other similar sounding items."[167] Arrow's

165. *See supra* notes 68–76 and accompanying text.

166. *See* Arrow, *supra* note 1, at 615 ("With suitable legal measures, information may become an appropriable commodity.").

167. *Id.* Sivaramjani Thambisetty similarly argues that patents do not provide an adequate solution to the disclosure paradox because they are not in fact "the sharp exclusive right that is central to [Arrow's] thesis." Sivaramjani Thambisetty, *Patents as Credence Goods*, 27 OXFORD J. LEGAL STUD. 707, 707 (2007). Thambisetty does not, however, question the need for intellectual property to resolve the disclosure paradox; his argument is confined to criticizing the current implementation of patent law on the ground that it fails to resolve the paradox. *Id.* at 707–09.

observation is consistent with a more nuanced conception of the information that is produced by and is necessary for innovation.

When the scope of intellectual property rights corresponds with the scope of information sought to be disclosed, then intellectual property may indeed solve the disclosure paradox. This is most likely to occur with respect to inventions that are relatively easy to "claim" through modern intellectual property regimes.[168] When claiming is effective, there is a one-to-one correspondence between the scope of protection of the patent and the invention. In this case, the invention can be disclosed and will be entirely protected from misappropriation by the scope of the patent.

But there are a variety of circumstances in which this one-to-one correspondence will break down.[169] For one thing, intellectual property may underprotect the information good that needs to be exchanged. For goods that are highly self-disclosing, revelation of the core information asset in the patent may facilitate design-around. That is, a potential buyer once exposed to the information can attempt to implement the invention covered by the patent with changes that remove the new effort from the patent's coverage. Designing around is a familiar phenomenon in patent law, and is often thought to represent a social welfare benefit.[170] But a rational information holder faced with the possibility that disclosing her information may lead to easy design-around will still be reluctant to disclose even if the information is protected by a patent.

The extent to which design-around poses a continuing danger to information holders who have intellectual property protection depends on several factors, including the timing of the negotiation over the information and the ability to draft broader patent claims.[171] In pharmaceuticals, for instance, negotiations over the rights to develop a compound often occur relatively early in the product-development cycle. At this stage, patent doctrine may prevent overly broad claims.[172] At the same time, because

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168. In the patent system, for example, the "claim" represents the "metes and bounds" of the invention. A rich literature details some of the difficulties associated with modern claiming, not the least of which is that it is highly uncertain. *See, e.g.*, BESSEN & MEURER, *supra* note 18, at 56–62 (discussing various processes for interpreting vague claims). More specifically for present purposes, claiming often proves to be both under- and over-inclusive. Dan L. Burk & Mark A. Lemley, *Fence Posts or Sign Posts? Rethinking Patent Claim Construction*, 157 U. PA. L. REV. 1743, 1750, 1765 (2009).

169. *Cf.* Lemley, *supra* note 4, at 740 (noting that patents usually do not correspond one-to-one with relevant product markets).

170. *See, e.g.*, Lemley, *supra* note 4, at 753 n.248 (listing courts and commentators that have recognized the value in design-around).

171. Conventional wisdom is that patent drafters attempt to draft claims as broadly as possible, but their ability to do so depends on the technology and the relevant doctrine in the area. Burk & Lemley, *supra* note 168, at 1762–63.

172. More specifically, the enablement doctrine limits the extent to which pharmaceutical companies may patent small molecules whose efficacy remains uncertain. *See, e.g.*, *In re* '318 Patent Infringement Litig., 583 F.3d 1317, 1327 (Fed. Cir. 2009) (holding that early-stage research failed to support a patent application for small-molecule drug treatment).

many small molecules may have similar biological effects, it is possible for a competitor, upon learning the focus of a company's research, to pursue its own research on a similar molecule that falls outside the scope of the patent. This goes a long way toward explaining why, in the biotech–pharmaceutical example with which this Article began, the patent that protects the molecule does not appear to play a role in the process of exchanging information. This is so despite the conventional wisdom that pharmaceuticals are the paradigmatic industry in which patents promote innovation.[173] Although patents may offer protection in the product market for pharmaceutical products, they appear to play a very different role in the market for development and commercialization rights. In software, where the evidence that patents play a significant role in the product market is much more attenuated,[174] it is not surprising that design-around is particularly easy as well.[175]

The alternative scenario in which patents fail to solve the disclosure paradox completely is when they underdisclose. The disclosure provided by a patent is limited. The Patent Act requires a patentee to provide, in addition to the "claims" described above,[176] "a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same."[177] Patentees can often draft their patent disclosures, however, in such a way as to keep significant—and significantly useful—information to themselves.[178] A skilled patent lawyer will draft the disclosure of a patent to meet the bare minimum requirements of the law without disclosing any information that can usefully be held back as a trade secret.[179] Even to the extent that patents do disclose useful information, there are a variety of

173. *See, e.g.*, BESSEN & MEURER, *supra* note 18, at 138–46 & fig.6.5 (concluding that positive returns to patent prosecution and litigation exist only in the chemical and pharmaceutical industries); DAN L. BURK & MARK A. LEMLEY, THE PATENT CRISIS AND HOW THE COURTS CAN SOLVE IT 80–81 (2009) (noting the importance of patents in the pharmaceutical industry).

174. *See, e.g.*, BURK & LEMLEY, *supra* note 173, at 40, 43, 47 (explaining features of IT industries that render patent protection less relevant for innovation).

175. *See* Colleen V. Chien, *Predicting Patent Litigation*, 90 TEXAS L. REV. 283, 291 (2011) ("Short life cycles and the ability to design around patents in the IT sector contribute to what Henry Chesbrough characterizes as a 'weak appropriability' regime in which it is more difficult for innovators to exclusively benefit from their innovations." (quoting HENRY CHESBROUGH, EMERGING SECONDARY MARKETS FOR INTELLECTUAL PROPERTY: US AND JAPAN COMPARISONS 31 (2006))).

176. *See* 35 U.S.C. § 112 ¶ 2 (2006) ("The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.").

177. *Id.* § 112 ¶ 1.

178. *See* Devlin, *supra* note 111, at 403 (noting that patents often fail to convey meaningful information); Jeanne C. Fromer, *Patent Disclosure*, 94 IOWA L. REV. 539, 563 (2009) (suggesting that the patent system encourages writers to underdisclose); Note, *The Disclosure Function of the Patent System (or Lack Thereof)*, 118 HARV. L. REV. 2007, 2025–26 (2005) (same).

179. *The Disclosure Function of the Patent System (or Lack Thereof)*, *supra* note 178, at 2026.

reasons to believe that they are insufficient as communication devices for information exchange. Patent documents are usually written by and for lawyers rather than by and for scientists or business people; as such, they often fail to communicate the relevant technical data in the most usable fashion.[180]

Putting these observations together yields the conclusion that the exchange of commercially useful information often requires parties to go beyond patents. As Arora observes, "most of the theoretical literature on licensing assumes that all technical knowledge is contained in patents or formulae," but "efficient technology transfer usually also requires the transfer of know-how."[181] Even to the extent, then, that patents facilitate the transfer of *some* useful knowledge, that transfer often must be accompanied by the simultaneous transfer of additional knowledge that is not the subject of intellectual property protection. It is not enough to share the details of a machine. You also need to share the inventor's insight into how it *works*. That brings back the same problems in transferring tacit knowledge described in subpart II(A). That knowledge is costly to transfer and its transfer is subject to opportunistic behavior.[182]

Economists have identified a role for patents in this transfer, but it is not the role that is assumed by the conventional account of the disclosure paradox. A patent can be thought of as one component of a package of knowledge that also includes know-how. Successful technology transfer requires transferring *all* components of the package.[183] But because the patent creates legal excludability, a license to use the subject matter of the patent can be withdrawn. One contracting strategy, therefore, is to use the complementarity between the excludable asset (the patent) and the nonexcludable asset (the know-how) to induce efficient contracting. The patent is effectively used as a "hostage" that can be withdrawn if payment is not made for the know-how; likewise, the buyer of the know-how can

180. *See* Sean B. Seymore, *The Teaching Function of Patents*, 85 NOTRE DAME L. REV. 621, 625–27 (2010) (describing why patent documents are not read more widely by scientists and business people).

181. Arora, *supra* note 121, at 41.

182. *See supra* notes 119–25 and accompanying text. Recall that the specific double opportunism associated with transferring tacit knowledge is that "[o]nce the know-how is transferred, the buyer may try to avoid paying for it, since it would be difficult to force her to unlearn what she has been taught. On the other side, given the cost of transferring know-how, the licensor may be tempted to skimp on the know-how provided." ARORA ET AL., *supra* note 39, at 118.

183. *See* Peter Lee, *Transcending the Tacit Dimension: Patents, Relationships, and the Industrial Organization of Technology Transfer*, 100 CALIF. L. REV. (forthcoming 2012) (manuscript at 21) (explaining that "even where patent disclosure satisfies statutory and doctrinal requirements, it is often lacking" and that technology transfer therefore must include "useful knowledge about patented inventions [that] remains tacit"), *available at* http://ssrn.com/abstract=2019335.

postpone at least part of the payment until the information has been transferred.[184]

Patents therefore can play a variable role in the exchange of valuable information. Sometimes they may facilitate transfer of the entire sum of useful knowledge. At other times, they may fall short. And sometimes they may be used in conjunction with other strategies. The ultimate conclusion, however, is that the multifaceted nature of information makes the use of a patent to overcome the disclosure paradox contingent.

2. Contracts.—The difficulties of contracting for the sale of information lie at the heart of the conventional account of the disclosure paradox. In a world in which information is a simple asset, opportunism will effectively prevent a contract for sale and will also prevent the parties from striking a separate contract for secrecy. But understanding that information is a complex, multifaceted asset reveals a range of contracting strategies by which parties may effectively accomplish exchange. Key to these strategies is that—consistent with the complexity of the information that parties seek to exchange—they take on features of privately agreed-to *governance* mechanisms rather than simple contracts.

The disclosure paradox is, at its heart, a problem of contract. A contract for the sale of information cannot be completed because of the threat of dual opportunism.[185] The parties generally cannot strike a one-time bargain for the sale of information because the seller fears the buyer can take the information without paying if she divulges first, and the buyer cannot value the information without disclosure.[186] Other tools of contract theory, including "earnouts" and other mechanisms contingent upon a determination of the value of the information following disclosure, also are generally ineffective.[187]

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184. ARORA ET AL., *supra* note 39, at 116–17 ("[E]fficient contracts for the exchange of technology can be written by exploiting the complementarity between know-how and any other technology input that the licensor can use as a 'hostage.'"); *see also* Arora, *supra* note 120, at 234–35 (proposing stronger intellectual property to facilitate contracting in this manner).

185. Arrow, *supra* note 1, at 614–16. These difficulties also are predicted by the transaction cost economics literature. *See, e.g.*, WILLIAMSON, *supra* note 85; *see also* Merges, *supra* note 5, at 1495–504 (explaining the property rights solution to the paradox as a means to establish precontractual liability).

186. *See* Cooter & Edlin, *supra* note 4, at 16 (describing this so-called "double trust dilemma"); Barnett, *supra* note 4, at 797–98 (noting that unwillingness to enter transactions reflects an "underlying drafting constraint"). Barnett generalizes from these difficulties to conclude that "contractual solutions cannot reliably overcome the disclosure paradox." *Id.* at 797. My analysis goes beyond Barnett's by relaxing his assumptions about the nature of the good to be traded. *Cf. id.* at 797–98 ("Suppose the typical scenario in which an inventor has formulated an idea and wishes to sell it to a large integrated firm.").

187. *See* Barnett, *supra* note 4, at 798–99 (outlining issues arising from "earnout" provisions). Several economists have modeled scenarios in which certain contractual mechanisms may facilitate the exchange of appropriable information. *See generally, e.g.*, James J. Anton & Dennis A. Yao, *The Sale of Ideas: Strategic Disclosure, Property Rights, and Contracting*, 69 REV. ECON. STUD. 513 (2002) (arguing that partial disclosure plus bond might overcome transactional problems in

The parties usually cannot overcome this difficulty through the use of a nondisclosure agreement, for a number of reasons. First, nondisclosure agreements themselves may fall victim to the disclosure paradox. Without knowing the information that the agreement might seek to protect, a buyer will generally be unwilling to subject herself to potential liability for violating the terms of the agreement. The problem is that the buyer may *already* know the information. In that case, a buyer who signs a nondisclosure agreement and only then learns of the subject matter the agreement covers is exposed to liability.[188] This explains the conventional wisdom that most venture capitalists or Hollywood studios routinely refuse to sign nondisclosure agreements.[189] These sources of capital hear hundreds if not thousands of pitches in a year. If they signed nondisclosure agreements prior to hearing every new idea, they would likely be exposed to massive liability when the ideas inevitably overlapped in some fashion, large or small.[190]

But the utility of contracts changes when the subject of exchange is viewed not as a singular stock tip but as a more complicated asset. Most importantly, the exchange of information often requires more than a single interaction. Multiple exchanges are sometimes necessary as a result of the inherent characteristics of the information. Tacit information that cannot be readily codified, for example, can only be transferred through multiple interactions among the parties to the exchange.[191] Alternatively, parties can structure the flow of information around their core assets to enable staged disclosure.[192] In all events, the need for multiple interactions expands

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technology contracts); Joshua S. Gans & Scott Stern, *The Product Market and the Market for "Ideas": Commercialization Strategies for Technology Entrepreneurs*, 32 RES. POL'Y 333 (2003) (identifying a range of commercialization strategies based on excludability and asset complementarity). I put these models aside for several reasons. First, there is no evidence that they are used in practice. Second, to the extent that they rely on the use of bonding mechanisms, they presuppose some independent wealth in the idea holder. *See, e.g.*, Anton & Yao, *supra*.

188. *See* Barnett, *supra* note 4, at 798 ("No idea buyer will covenant against use since the idea buyer may already possess the idea, in which case it would be exposed to expropriation by the idea seller."); Bar-Gill & Parchomovsky, *supra* note 39, at 405 (noting that buyers are unlikely to sign a nondisclosure agreement without receiving substantial disclosure from the seller beforehand); Lemley, *supra* note 111, at 337 (same).

189. Lemley, *supra* note 111, at 337.

190. *See* Barnett, *supra* note 4, at 798; Lemley, *supra* note 111, at 337 & n.109 (noting that "[b]oth venture capitalists and Hollywood executives . . . are notoriously unwilling to sign nondisclosure agreements before reading business plans or movie scripts"); Bar-Gill & Parchomovsky, *supra* note 14, at 1678 ("Powerful parties . . . often refuse to sign NDAs and instead demand that the disclosing party sign a legal document that releases the powerful party from all liability if the information is somehow disclosed."). Anton and Yao model the circumstances under which an information seller will waive confidentiality rights—in effect a reverse-NDA. They conclude that such waivers help persuade skeptical buyers to participate in the exchange. James J. Anton & Dennis A. Yao, *Attracting Skeptical Buyers: Negotiating for Intellectual Property Rights*, 49 INT'L ECON. REV. 319, 319 (2008).

191. *See supra* note 125 and accompanying text.

192. *See supra* notes 155–59 and accompanying text.

significantly the range of contractual mechanisms that can help facilitate the transfer of information.

Indeed, contracts for the sale of information more closely resemble governance mechanisms than simple transactions.[193] Because the exchange either requires or can be structured as a series of interactions, contractual governance structures can be erected that support this relationship. Notably, these governance structures do not contemplate vertical integration of the sort typically posited as the alternative to market-based exchange in the absence of reliable solutions to the disclosure paradox.[194]

As an example, recall from the previous discussion that the ability to withhold tacit knowledge allows holders of biotech platform technologies freely to disclose the nature of those technologies without fear of misappropriation.[195] The contractual work that remains facilitates the exchange of deeper know-how once the parties have determined that they are interested in further dealings. In 1997, Millennium Pharmaceuticals, at that time a leading biotechnology company with technology centered on genomic analysis, entered into an agreement with the agricultural products giant Monsanto.[196] That deal was the result of an initial negotiation similar to that described above. Monsanto employees toured Millennium facilities as the parties conducted due diligence, learning about the kinds of platform technologies that Millennium possessed, and determining which technologies were potentially of interest.[197] The subsequent contract established a new entity called Cereon, structured as a wholly owned subsidiary of Monsanto.[198] Millennium agreed to provide support to Cereon in utilizing Millennium's platform technologies in return for royalty payments.[199] In order to guard against appropriation of the technology beyond the scope of the agreement, the parties put in place a set of complicated monitoring and

193. I use the term "governance" as it is used in the transaction cost economics tradition to refer to "the ex post support institutions of contract." WILLIAMSON, *supra* note 82, at 29 (emphasis omitted). The questions that branch of contract theory asks include: "What institutions are created with what adaptive, sequential decision-making and dispute settlement properties?" *Id.* I follow Gilson, Sabel, and Scott in adapting this view to the particular problems of contracting in the face of significant uncertainty and information asymmetries. Ronald J. Gilson et al., *Contracting for Innovation: Vertical Disintegration and Interfirm Collaboration*, 109 COLUM. L. REV. 431, 433 n.1 (2009).

194. *Cf.* Barnett, *supra* note 4, at 803–05; Burk & McDonnell, *supra* note 14, at 587–88.

195. *See supra* notes 133–34 and accompanying text.

196. Millennium Pharm., Inc., Current Report (Form 8-K) 3 (Nov. 4, 1997).

197. *See supra* note 15.

198. *See supra* note 196; Millennium Pharm., Inc., Amendment No. 1 to Current Report (Form 8-K/A) 2 (Jan. 30, 1998); *Monsanto Company IPO Overview*, NASDAQ (Oct. 18, 2000), http://www.nasdaq.com/markets/ipos/company/monsanto-co-new-76144-2630 ("Cereon is our wholly owned subsidiary.").

199. *See* Millennium Pharm. Inc., Amendment No. 1 to Current Report (Form 8-K/A) 42, 49 (Jan. 30, 1998) (discussing the terms of Monsanto's royalty payments to Millennium).

governance mechanisms.[200] These mechanisms included joint committees that would meet at regular intervals and a procedure for resolving disputes.[201] In short, they governed not the terms of the information itself, but the manner in which the parties would interact over the course of the information exchange. The initial exchange was enabled by Millennium's ability to withhold know-how; the contractual terms then specified the conditions for future exchange.

These contracts are similar in nature to the contracts in disaggregated supply chains that Gilson, Sabel, and Scott refer to as "contract[s] for innovation."[202] The problem that Gilson, Sabel, and Scott address is different from but analogous to the problem of contracting around the disclosure paradox. They begin with two observations: that supply chains across a wide variety of industries have been disaggregated, and that the pace of technological innovation compels these disaggregated suppliers to collaborate closely to bring new products to market.[203] In the face of significant uncertainty about the final shape that these products will take, buyers and suppliers do more than just enter into arm's-length supply arrangements (or simply vertically integrate). Instead, the transactions that take place among disaggregated firms "involve novel forms of collaboration" and "carefully organized exchanges of information designed to identify and utilize possibilities for innovation."[204] The contracts that underlie these relationships establish "elaborate governance mechanisms in lieu of the more familiar risk-allocation provisions of conventional contracts"—and often little else[205]—through which the parties engage in mutual information sharing and product development over the course of several years.[206] Gilson, Sabel, and Scott describe these governance mechanisms as "a rich braiding of formal and informal terms that deters opportunism during the collaborative/learning phase of the contract."[207] The contracting challenge that Gilson, Sabel, and Scott confront is how parties can make asset-specific investments to develop new products collaboratively in the face of uncertainty about both one another's capabilities and the final product. The parties overcome the threat of opportunism in such situations by engaging in

200. *See id.* at 23–35, 41–42, 54 (establishing joint committees and teams responsible for coordinating the research program and disclosing information between parties as well as establishing a duty of cooperation between parties).

201. *Id.* at 23–26, 56–60.

202. *See* Gilson, Sabel & Scott, *supra* note 193, at 436.

203. *Id*. at 431.

204. *Id.* at 436–37.

205. *Id.* at 449; *see id.* at 460 (describing an exemplar agreement between John Deere and a supplier that does not specify any supply orders).

206. *Id.* at 472–73.

207. *Id.* at 473; *see also* JOHN HAGEL III & JOHN SEELY BROWN, THE ONLY SUSTAINABLE EDGE: WHY BUSINESS STRATEGY DEPENDS ON PRODUCTIVE FRICTION AND DYNAMIC SPECIALIZATION 91–95 (2005) (describing mechanisms for building "dynamic trust" in the context of loosely coupled process networks).

a collaborative process that both builds trust—and therefore enables the exchange of increasingly sensitive and detailed information about each party's technical knowledge and capabilities—and raises the switching costs of finding another partner, thereby discouraging defection.[208]

Parties seeking to transfer complex information face some similar impediments. Unlike contracts for collaborative product development, contracts for the exchange of information may contemplate a single project. But like the Gilson, Sabel, and Scott contracts, they require the development of mechanisms to promote trust and limit opportunism. The exchange of sensitive information requires trust on both sides. Governance mechanisms that elaborate the terms by which parties will structure an ongoing relationship provide a contractual foundation for building that trust over time.

One can also see the "braiding" of legally enforceable obligations with informal obligations in the arrangements that parties seeking to exchange information may make. Returning to the example of pharmaceutical licensing,[209] recall that the negotiations between large pharmaceutical manufacturers and biotechs are carried out in stages. In the first stage, the parties engage in disclosure of information without any contractual protections. Should the parties prove interested in further disclosures, however, they typically will sign a NDA. The NDA creates binding legal obligations, though litigation over these agreements is rare. These NDAs are signed more for the signal they send to the parties and to outsiders about the seriousness of the ongoing negotiation than for the actual contractual protection provided. Similarly, when the parties have reached basic agreement on the contours of the deal and are ready to conduct in-depth disclosures and exchange of information as part of their mutual due diligence, they will sign a "term sheet." This term sheet may or may not be a binding contract, but it again signals that the negotiations have reached a stage where serious disclosures are being made. At each stage of the process, the public signaling provided by the parties' willingness to sign a contract operates to increase that party's liability not in litigation, but in the court of public opinion in the relevant norm community.[210] In this manner, the parties braid together contract-based mechanisms and informal norms based on trust and reputation signaling to accomplish a deepening exchange of information over time.

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208. *See* Gilson et al., *supra* note 193, at 472 ("The contracting problem is to craft a structure that (1) induces efficient, transaction-specific investment by both parties; (2) establishes a framework for iterative collaboration and adjustment of the parties' obligations under conditions of continuing uncertainty . . . ; and (3) limits the risk of opportunism that could undermine the incentive to make relation-specific investments in the first place.").

209. *See supra* note 15 and accompanying text.

210. *See infra* note 232 and accompanying text (discussing reputational harms as a mechanism for inducing disclosure).

3. Norms.—Legal scholars have long understood that norms as well as law play a significant role in shaping private behavior.[211] In the production of intellectual goods, a well-developed literature seeks to understand what incentives individuals have to innovate in the absence of intellectual property.[212] Norms can support and regulate the exchange of information as well as its production. As the previous Part demonstrated, parties have some ability self-consciously to structure the information flows around their products and ideas. These flows of information are often shaped by norms in the industries and communities of which information holders are a part.

Take, for example, the classic comparison of technology clusters in Silicon Valley and Route 128 in Massachusetts.[213] Saxenian was the first to explain that the relative success of Silicon Valley was attributable to that area's comparatively efficient transfer of useful knowledge between and among firms.[214] In Saxenian's account, subsequently followed by Gilson and Hyde, the critical driver of economic performance in Silicon Valley was an industrial organization that encouraged the free flow of information between firms. This allowed firms to develop an industrial market structure particularly conducive to innovation. As Gilson writes, Silicon Valley entrepreneurs "moved between companies, founded start-ups, supplied former employers, purchased from former employees, and in the course of

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211. *See, e.g.*, ROBERT C. ELLICKSON, ORDER WITHOUT LAW: HOW NEIGHBORS SETTLE DISPUTES 282–83 (1991) (concluding that norms influence private behavior more than law in "some spheres of life").

212. There are at least two strands to this literature. The first explores the mechanisms that underlie alternative production systems that are based neither in markets nor hierarchies. The seminal contribution to understanding commons-based peer production is YOCHAI BENKLER, THE WEALTH OF NETWORKS: HOW SOCIAL PRODUCTION TRANSFORMS MARKETS AND FREEDOM (2006). The second strand explores intellectual property's "negative space," that is, areas of intellectual production that succeed in the absence of intellectual property. *See, e.g.*, Dotan Oliar & Christopher Sprigman, *There's No Free Laugh (Anymore): The Emergence of Intellectual Property Norms and the Transformation of Stand-Up Comedy*, 94 VA. L. REV. 1787, 1859–62 (2008) (discussing informal social norms that protect stand-up comedians' material); Emmanuelle Fauchart & Eric von Hippel, *Norms-Based Intellectual Property Systems: The Case of French Chefs*, 19 ORG. SCI. 187, 188 (2008) (discussing implicit social norms that protect French chefs' recipes). Unlike the former, the discussion here is concerned primarily with exchange rather than production, though the two admittedly go hand-in-hand at times; unlike the latter, the discussion here is concerned not with proprietary norms but with the norms that encourage and support exchange.

213. *See, e.g.*, ANNALEE SAXENIAN, REGIONAL ADVANTAGE: CULTURE AND COMPETITION IN SILICON VALLEY AND ROUTE 128, at 1–4 (1994) (describing the differences in productive organization between Silicon Valley and Route 128); Ronald J. Gilson, *The Legal Infrastructure of High Technology Industrial Districts: Silicon Valley, Route 128, and Covenants Not to Compete*, 74 N.Y.U. L. REV. 575, 586–94 (1999) (same); *see generally* ALAN HYDE, WORKING IN SILICON VALLEY: ECONOMIC AND LEGAL ANALYSIS OF A HIGH-VELOCITY LABOR MARKET (2003) (arguing that the culture of start-ups in Silicon Valley is the "key influence" on factors that distinguish it from Route 128).

214. *See* SAXENIAN, *supra* note 213, at 34–37 (explaining that Silicon Valley was "distinguished by the speed with which technical skill and know-how diffused within a localized industrial community" and that the diffusion of knowledge "enhanced the viability of Silicon Valley start-ups"); *see also* Gilson, *supra* note 213, at 586–94 (summarizing and agreeing with Saxenian's basic account).

their careers developed personal and professional relationships that cut across companies and competition."[215] In Massachusetts's high-tech corridor along Route 128, by contrast, firm mobility was low and the flow of information was much more tightly controlled.[216]

Critically, the regulation of information flows in these two cases was determined by a combination of norms and law. Gilson argued famously that legal rules drove norms.[217] In his view, the unenforceability of covenants not to compete in employment contracts as a matter of California state law marked a critical legal difference with Massachusetts that allowed the norms of employee mobility and easy information exchange to flourish.[218] Hyde, by contrast, argued that the norms shaped the applicable law.[219] In all events, the interaction of a complex set of cultural and legal institutions determined—in two different geographies—whether and to what extent valuable knowledge was shared and shaped the resulting economic effect.

The story of Silicon Valley and Route 128 illustrates important ways in which norms can affect information sharing. I highlight three that may be of particular importance in overcoming the disclosure paradox: norms of reciprocity, attribution, and reputation. These norms support the exchange of information by serving as limitations on opportunism.

In many communities of technologists and entrepreneurs, there is a strong norm favoring free exchange of information based not on altruism or idealism, but on a calculation that reciprocity is to everyone's advantage. Venture capitalists, for example, describe the value of "being in the mix." Industry participants who share information about their businesses generate interest among investors and potential partners. Similarly, idea sharing among the entrepreneurial community leads to opportunities for collaboration or other joint efforts that may yield important business advantages. Overprotection of intellectual assets in that environment actually operates as a competitive disadvantage.[220]

Management scholars have described at least two aspects of this norm in greater detail. The first is the need for learning in addition to innovation. Cohen and Levinthal explain that investment in R&D is useful to firms not only to generate new information, but to allow firms to "identify, assimilate, and exploit knowledge from the environment."[221] Learning, in other words, is just as important as innovation. Firms derive a benefit, they argue, from engaging in research and development despite the fact that the knowledge

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215. Gilson, *supra* note 213, at 590.

216. *Id.* at 591–92.

217. *Id.* at 578.

218. *Id.* at 609.

219. HYDE, *supra* note 213, at 15–24.

220. *See* Gans & Stern, *supra* note 187, at 343–45 (describing conditions necessary for development of reputation-based markets for idea exchange).

221. Wesley M. Cohen & Daniel A. Levinthal, *Innovation and Learning: The Two Faces of R&D*, 99 ECON. J. 569, 569 (1989).

generated may be partially—or even mostly—appropriable by others because such engagement improves firms' "absorptive capacity."[222] The need to build absorptive capacity is directly related to the complexity and transferability of information in the relevant technological area.[223] In areas marked by inherently tacit or difficult-to-transfer knowledge,[224] generating spillovers helps a firm build its own capacity to take advantage of others' spillovers.[225] The incentive to be "in the mix" is therefore correlated with the need to accomplish more difficult transfers of information.

Powell adds to this analysis by demonstrating that networks of learning, in which information is freely exchanged among participants in the network, develop in response to the need to understand and absorb widely dispersed and quickly evolving information.[226] "When there is a regime of rapid technological development, research breakthroughs are so broadly distributed that no single firm has all the internal capabilities necessary for success."[227] In that environment, "the locus of innovation is found in a network of interorganizational relationships" that require reciprocity for ongoing collaboration.[228] Firms that attempt to restrain the flow of knowledge often will find themselves excluded from the network by operation of the reciprocity norm. A Silicon Valley firm, for example, that acquires a reputation for suing its employees when they take knowledge elsewhere will find it hard to recruit and retain talent.[229]

At times, this norm of reciprocity is supported by a norm of attribution, at least in cases where the valuable currency that needs protection is credit for one's work. Academic discourse is a critical example here. Norms of sharing have long been part of the scientific and academic process.[230] But

222. *Id.* at 593–94.

223. *See id.* at 593 (suggesting that "the characteristics of knowledge that affect the ease of firm learning" influence the degree of investment in research and development).

224. *See supra* notes 136–37 and accompanying text.

225. *See* Frischmann & Lemley, *supra* note 164, at 268–69 (describing a "virtuous cycle" created by spillovers that increases the overall investment in research and development).

226. *See* Walter W. Powell et al., *Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology*, 41 ADMIN. SCI. Q. 116, 143 (1996) (explaining that networks form to access relevant knowledge that is widely dispersed and rapidly expanding); *see also* Jason Owen-Smith & Walter W. Powell, *Knowledge Networks as Channels and Conduits: The Effects of Spillovers in the Boston Biotechnology Community*, 15 ORG. SCI. 5, 6 (2004) (explaining that networks improve rates of learning and access to knowledge).

227. Powell et al., *supra* note 226, at 117.

228. *Id.* at 119.

229. *See* SAXENIAN, *supra* note 213, at 41 (noting that Silicon Valley was far less litigious than other parts of the country); *see also* Michael J. Madison et al., *Constructing Commons in the Cultural Environment*, 95 CORNELL L. REV. 657, 696–97 (2010) (describing a similar phenomenon in patent pools).

230. *See, e.g.*, Rebecca S. Eisenberg, *Proprietary Rights and the Norms of Science in Biotechnology Research*, 97 YALE L.J. 177, 180–84 (1987) (highlighting the norms of community and sharing in scientific research); Arti Kaur Rai, *Regulating Scientific Research: Intellectual Property Rights and the Norms of Science*, 94 NW. U. L. REV. 77, 88–94 (1999) (noting that traditional scientific norms promote freely available information).

ideas and information are the stock-in-trade among academics. To protect the valuable asset associated with being the first to generate or publicize information, academics have long relied on a norm of attribution.[231] Attribution (and its counterpart, a strong antiplagiarism norm) effectively allows academics to capture value from their contributions to the literature—in the form of enhanced reputation, career prospects, etc.—while simultaneously disclosing their intellectual output to the broader community.

Finally, these norms also are supported by reputational constraints. It is well understood, for example, that venture capital firms overcome the disclosure paradox in part by relying on their reputations.[232] These firms require access to private information in order to complete financing deals; their access to such information depends critically on their reputations as repeat players. A firm that divulges private information is not likely to find many entrepreneurs seeking financing from it in the future. There is no reason to believe that venture capital is sui generis in this regard; reputational effects can and do play a role in information exchange more broadly.[233] Indeed, reputation is a critical part of the operation of licensing deals between pharmaceutical and biotechnology companies. The reputation effect arises because consolidation in the pharmaceutical industry has left relatively few large firms capable of carrying out the development and marketing necessary to commercialize the products of biotechnological research. These few firms are therefore the primary "customers" of biotech firms seeking to license their potential targets. At each stage of the negotiation over the potential licensing of a biotechnology-based compound, the likelihood of reputational harm to a pharmaceutical company that misappropriates sensitive information increases. At each step of the process, the additional reputational risk that the pharmaceutical company takes on increases the ability of the biotechnology company to make further disclosures.

4. Alternative Sources of Appropriability.—Certain features of the broader business and legal environment can also support the strategies described above. These mechanisms operate in the background, insofar as they provide the parties with additional assurance that they can retain some value despite their disclosures. They therefore form an important part of the story about how transactions in information can take place, even in the absence of intellectual property rights.

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231. Catherine L. Fisk, *Credit Where It's Due: The Law and Norms of Attribution*, 95 GEO. L.J. 49, 81–85 (2006); *see also* Oliar & Sprigman, *supra* note 212, at 1829–30 (describing the attribution norm in stand-up comedy).

232. *See* Bar-Gill & Parchomovsky, *supra* note 14, at 1689 & n.156; Ronald J. Gilson, *Engineering a Venture Capital Market: Lessons from the American Experience*, 55 STAN. L. REV. 1067, 1085–87 (2003) (discussing the benefits of an effective reputation market to support the transfer of discretion between an entrepreneur and venture capital fund).

233. *See supra* notes 20–21 and accompanying text.

There is a significant economic literature that demonstrates that intellectual property is not the only mechanism by which a party can appropriate the gains from its investment in R&D.[234] Innovators can and do rely on a host of other methods to ensure that they can receive an adequate return on their investment. These mechanisms can substitute for intellectual property not only with respect to the generation of *ex ante* incentives to engage in innovative activity, but also in solving the *ex post* expropriation problem that comprises the disclosure paradox.

In his classic work, David Teece explains that innovators have numerous sources of "appropriability"—the "ability to capture the profits generated by an innovation."[235] These sources vary with the market structure of an industry, business strategy of a firm, and the legal environment in which both operate.[236] While patents often play an important part in firms' strategies to appropriate the gains from research and development, they rarely allow for perfect appropriability;[237] they are not, therefore, the sole means by which firms profit from innovation.

Teece highlights two alternative sources of appropriability. The first is the first-mover advantage. When an innovator is the first to market, she occupies the entire market for a time.[238] During that time of de facto exclusivity, the innovator may directly recoup much of her investment.[239] The innovator may also be able to execute strategies that preserve long-term competitive advantage during the time when the market is relatively uncompetitive. Building a brand name and customer loyalty, for example, or developing a competitive advantage with respect to supplies or manufacturing, could produce appropriable rents for many years after competitors enter the market.[240] The second alternative source of appropriability is the ability of owners of complementary assets to leverage their ownership over such assets to charge supracompetitive prices even for unprotected innovations.[241] Innovators following this strategy rely not on the

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234. DAVID J. TEECE, MANAGING INTELLECTUAL CAPITAL: ORGANIZATIONAL, STRATEGIC, AND POLICY DIMENSIONS (2000); Levin et al., *supra* note 32; COHEN ET AL., *supra* note 32.

235. David J. Teece, *Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RES. POL'Y 285, 287 (1986).

236. *Id.*

237. *See supra* notes 166–68 and accompanying text.

238. *See* Teece, *supra* note 235, at 286 (noting that a "first-to-market advantage" can be "translated into a sustained competitive advantage which either creates a new earnings stream or enhances an existing one").

239. *Id.*; *see also* Roger A. Kerin et al., *First-Mover Advantage: A Synthesis, Conceptual Framework, and Research Proposition*, 56 J. MKTG. 33, 34 (1992) (citing Eric von Hippel, *Appropriability of Innovation Benefit as a Predictor of the Functional Locus of Innovation* (Nat'l Sci. Found., Working Paper No. 1084-79, 1984), *available at* http://pdf.aminer.org/000/326/964/perceived_net_benefit_as_a_measure_of_is_success_and.pdf) (stating that the first mover may be in a "position to gain higher profits than would be possible in a competitive marketplace").

240. TEECE, *supra* note 234, at 30, 121–22.

241. ARORA ET AL., *supra* note 39, at 116–17; Teece, *supra* note 235, at 288–90.

innovation for their competitive advantage, but on their unique ability to control use of the innovation through other means.

Each of these alternative mechanisms for appropriating the gains from research and development can also support information exchange by enabling parties to retain value derived from their information even after disclosure. In biotechnology, for example, disclosure of the structure of a molecule to a pharmaceutical company does not automatically divest the biotech of competitive advantage. It is already several years farther along the path towards development and marketing. Given the lengthy and complicated FDA approval process, a competitor in possession even of the structure of the molecule may have difficulty catching up.[242]

Or consider the sources of value in software.[243] Both entrepreneurs and venture capital investors agree that the value of a potential startup is determined primarily not by the idea motivating the business but by the ability of the putative company to execute the idea. Early-stage venture capitalists may see up to 1,000 companies in a year, and make investments in twenty to thirty of them. Among these business proposals, there will be much overlap and repetition. The likelihood is that a venture capitalist will see multiple iterations of the same idea. The source of value creation in that industry, however, is not primarily in the idea. Rather, it is in the execution. Venture capitalists certainly are interested in creative solutions to problems that represent good market opportunities, but most of their due diligence time is spent evaluating the entrepreneur and her team, and determining whether she can effectively bring the idea to fruition. Because the idea itself is of relatively lower value compared with the complementary assets that the entrepreneur and her team bring to the table, the entrepreneur can potentially disclose the idea to potential investors or collaborators and rely upon her superior skills to prevent misappropriation.

Industrial structure can also provide a source of appropriability. Anton and Yao demonstrate that under certain conditions an information holder may still profit from her disclosure of the information prior to coming to terms. Specifically, they model a scenario in which a financially weak inventor discloses the information to a potential partner, and extracts surplus by threatening to disclose the invention to the partner's competitors.[244] If the inventor has sufficient financial resources, she may be able to negotiate a contract *ex ante* by bargaining some of those resources should the idea prove unworkable.[245]

Finally, some degree of appropriability also can be provided by legal doctrines other than positive law, property rights-style intellectual property.

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242. *See supra* note 158.

243. *See supra* note 160.

244. James J. Anton & Dennis A. Yao, *Expropriation and Inventions: Appropriable Rents in the Absence of Property Rights*, 84 AM. ECON. REV. 190, 191–92 (1994).

245. *Id.* at 191, 203.

Trade secrecy is the most likely candidate to replicate the functions of intellectual property, especially insofar as it grants certain limited entitlements to the holders of information that cannot be protected through conventional patent or copyright.[246] As Mark Lemley points out, the property-like aspects of trade secrecy can help overcome Arrow's paradox in much the same way that patent or copyright can.[247] Even in the absence of an explicit NDA, courts can infer a confidential relationship in certain circumstances, and thereby hold one party liable for misappropriation of a trade secret.[248] Some states also provide direct protection for the exchange of ideas under the rubric of "idea submission law."[249] Although the details vary by state, these doctrines generally create liability for the misappropriation of ideas divulged in the course of soliciting development, when such ideas are sufficiently concrete and novel. Although the various doctrines that states apply are inconsistent with one another and inconsistently applied,[250] they too form the basis for an argument that *ex post* liability may confer enough protection to sustain a negotiation for the sale of information.

Some authors have been skeptical of trade secrecy's efficacy in promoting exchange. Bar-Gill and Parchomovsky, for example, criticize the use of trade secrecy on the ground that it is not a right in rem, but merely in personam.[251] But in personam rights protected through liability rules are the traditional tools for ensuring the smooth operation of commercial exchange.[252] So the question with respect to exchange of information is whether liability-rule treatment will depart in meaningful ways from the

246. Lemley, *supra* note 111, at 338–41. Trade secrets are generally defined broadly to include a wide variety of confidential and valuable business information. *See* UNIF. TRADE SECRETS ACT § 1(4) (amended 1985), 14 U.L.A. 538 (2005) (defining trade secrets as "information . . . that: (i) derives independent economic value . . . from not being generally known to . . . other persons who can obtain economic value from its disclosure or use, and (ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy"); RESTATEMENT (THIRD) OF UNFAIR COMPETITION § 39 (1995) (defining trade secrets as "any information that can be used in the operation of a business . . . and that is sufficiently valuable and secret to afford an actual or potential economic advantage over others").

247. Lemley, *supra* note 111, at 336–37.

248. *Id.* at 337.

249. *See* Bar-Gill & Parchomovsky, *supra* note 14, at 1681–84 (discussing state common law doctrines designed to protect ideas in certain circumstances); Arthur R. Miller, *Common Law Protection for Products of the Mind: An "Idea" Whose Time Has Come*, 119 HARV. L. REV. 705, 718–32 (2006) (advocating more robust protection for ideas); *see generally* Mary LaFrance, *Something Borrowed, Something New: The Changing Role of Novelty in Idea Protection Law*, 34 SETON HALL L. REV. 485 (2004) (discussing the evolution of idea protection doctrine in New York and New Jersey).

250. *See* Bar-Gill & Parchomovsky, *supra* note 14, at 1681 (observing that state judicial efforts to "afford protection to ideas" have "resulted in a largely inconsistent and incoherent body of law"); Miller, *supra* note 249, at 718 (noting that state law doctrines "have met heavy resistance, with scholars criticizing their variegated and unpredictable application").

251. *See* Bar-Gill & Parchomovsky, *supra* note 14, at 1677–78.

252. *Cf.* Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1110 (1972) (explaining that liability rules are often used over property rules in order to achieve efficient valuation in a market).

commercial norm. In light of the more detailed conception of information described above, there is at the very least reason to think an appropriately tailored *ex post* remedy for wrongful precontractual use of information may help support contracting even in the absence of *ex ante* property rights.

This Part has demonstrated several flaws with the conventional understanding of the disclosure paradox. Because that understanding is founded upon unrealistic assumptions about the nature of information, it leads to an overly simplistic solution. As an asset and the subject of commercial exchange, information often is neither wholly nonexcludable nor entirely homogeneous. The variegated nature of information gives rise to a number of strategies for ensuring its exchange that the existing literature underappreciates. Sometimes the characteristics of the information itself allow for it to be exchanged without significant threat of appropriation. At other times, parties may employ a range of techniques including, but not limited to, intellectual property protection to disclose information without giving up all of its value. Ultimately, the precise circumstances in which one or another technique may be useful will vary with the characteristics of the information the parties seek to exchange and the legal and business environment in which they seek to exchange it.

III. Using Policy Tools to Promote Information Exchange

As Part II has demonstrated, the conventional account of the disclosure paradox is, at best, a significant oversimplification of the process of exchanging information. Even in the area where one would most expect to see intellectual property playing a core role in facilitating the exchange of highly self-revealing information—pharmaceuticals—there exist both theoretical reasons to believe that intellectual property is not as necessary as many have suggested and at least anecdotal evidence that parties can utilize a variety of non-intellectual-property-based strategies for accomplishing exchange. Indeed, despite the fact that the core asset may be protected by intellectual property, parties still rely on these alternatives.[253] Intellectual property therefore may not be playing the role traditionally ascribed to it; that is, it may not always be *sufficient* for information exchange. And Part II also offered examples where information exchange takes place in the absence altogether of intellectual property. That suggests that intellectual property may not always be *necessary* for information exchange. The utility of intellectual property in facilitating information exchange therefore is just as contingent on specific technological and economic circumstances as that of the other methods described in Part II.

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253. This is not to say that intellectual property is useless in pharmaceuticals. In this analysis, I have focused solely on the effects of intellectual property in the market for research inputs rather than in the market for finished products. There is significant evidence to suggest that in fact intellectual property remains highly useful in pharmaceuticals and biotech. *See supra* note 173 and accompanying text.

These conclusions cast doubt upon a core argument in favor of expanding intellectual property. Recall from Part I that the unique economic function that underlies commercialization theory is the linking of ideas and capital or skills. Commercialization theory justifies intellectual property on the ground that it facilitates the development and commercialization of early-stage inventions.[254] It does so, in this telling, by solving the disclosure paradox. But if intellectual property does not solve the disclosure paradox in all cases—if, indeed, neither the disclosure paradox nor the intellectual property solution operates as the commercialization theorists predict—then commercialization cannot be a stand-alone justification for intellectual property.[255]

Two notes of qualification are appropriate here. First, my normative claim is limited. The theory and evidence presented in Part II support the conclusion that commercialization theory rests on assumptions that likely are not justified. It does not support—and I do not draw from it—the conclusion that intellectual property *never* operates to promote commercial exchange or that the commercialization rationale *never* justifies a particular change to intellectual property policy. My argument instead is that commercialization theory cannot justify expanded intellectual property without qualification or in all circumstances. The extent to which a particular change is justified will depend on a complicated social welfare calculus that I begin to sketch in only the broadest of terms in subparts III(A) and III(B) below.

Second, my analysis is limited to the commercialization rationale for intellectual property. I recognize, however, that the policy tools of positive intellectual property law operate across the theories that scholars use to justify those tools. Changes made (or not) with one theory in mind will necessarily impact the operation of the intellectual property system as it relates to other views or theories. Expanding or contracting the scope of intellectual property to achieve a particular policy objective justified by the commercialization theory will have an impact on broader incentives to innovate, and vice versa.

Putting these observations together, the argument for caution presented here is strongest with respect to proposals that seek to introduce intellectual property into areas where it has not previously existed solely on the ground that doing so would facilitate exchange of the newly protected subject matter. In other words, we should be especially cautious about protecting ideas on the ground that doing so will enable a market for their exchange. So too with respect to the more commonly made argument that intellectual property

254. *See supra* subpart I(A).

255. Intellectual property may, of course, be justified on other grounds. *See supra* notes 23–24 and accompanying text. I do not question those grounds for the purpose of this Article. Nevertheless, to the extent that particular arguments for expanding or augmenting intellectual property depend on the commercialization theory alone, the argument in this Part urges caution.

should be broadened and strengthened for a variety of early-stage inventions and creations.[256]

That said, the question remains what, if anything, policymakers can do to promote robust markets for information exchange. After all, effective exchange of information for the purpose of development and commercialization is critical to innovation.[257] The remainder of this Part lays out some of the considerations that may ultimately guide any policy analysis. I do not make the claim here that the mechanisms described in Part II are better or worse than intellectual property as a matter of social welfare. There is simply not enough data to draw any conclusions about the relative social welfare benefits of the various mechanisms that parties can use to minimize or overcome the disclosure paradox. The social welfare analysis is complicated and ultimately turns on the particular technological, legal, and business circumstances surrounding the proposed exchange. Determining the conditions under which one or another policy tool may be socially optimal therefore requires a deeper empirical understanding of the dynamics of information exchange across different industries and geographies.

A. Costs and Benefits

In the basic social welfare calculus, any given policy tool should be adopted if its benefits exceed its costs. As described earlier, the proponents of commercialization theory have identified a static benefit to intellectual property—it reduces the transaction costs associated with exchanging information.[258] Part II demonstrates that this benefit may not be as significant as many believe.[259] Yet there are likely situations in which intellectual property really is a necessary condition for information exchange. And even shy of that, there will be circumstances in which intellectual property offers a less costly solution to the disclosure paradox than other methods of exchange. Intellectual property allows for standardization of commercial exchange, for example, while contract- and norms-based methods require more costly customization of the interaction.[260]

But even accepting the benefits of the intellectual property solution as a given, they must still be weighed against the costs. The social welfare costs of intellectual property are well understood. The classic economic analysis of intellectual property posits a tradeoff between static costs and dynamic benefits.[261] The static cost arises from the fact that the exclusive right

256. *Cf. supra* notes 68–93 and accompanying text.

257. *See supra* notes 66–67 and accompanying text.

258. *See supra* note 97 and accompanying text.

259. *See supra* section II(B)(1).

260. *See* Kieff, *supra* note 77, at 333–34 (arguing that IP regimes are "fairly effective in facilitating the coordination among complementary users of the IP-protected subject matter that can help get it commercialized").

261. Wu, *supra* note 64, at 131.

provided by intellectual property allows the rights holder to price the intellectual good above marginal cost.[262] Deadweight loss results.[263] Usually this deadweight loss is offset by the dynamic benefit of incentives to create the good in the first place.[264] With intellectual property, intellectual products may be priced inefficiently, but there will be more of them. This is the classic "access–incentive" tradeoff.[265]

But intellectual property also entails a further dynamic cost. That cost arises because information is not only an end product, but also an input into future innovation.[266] As a result, innovation is cumulative. It is not a one-time activity that produces a new product. It often is an ongoing process of improvement. New innovators build on and improve upon what has come before.[267] Intellectual property can interfere with this process in several ways.[268] First, as Arrow himself recognized, "The preinvention monopoly power acts as a strong disincentive to further innovation."[269] It generally is easier for a monopolist to rely on monopoly rents than to engage in further product development, as might be necessary in a competitive market.[270] Second, intellectual property gives the initial inventor or creator control over potential improvements and new uses of her work.[271] That "leaves improvers vulnerable to bargaining breakdown, strategic behavior, or valuation error."[272] Simply put, intellectual property allows the rights holder to deny downstream innovators or improvers access to the original work. Finally, a variety of mechanisms may raise the cost of potential improvements. When making new products requires the use of a large number of inputs, each of which is independently protected by intellectual property, the cost of aggregating the rights to engage in downstream production may be prohibitively high.[273] This is the "anticommons" problem that often is

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262. *Id.*

263. *Id.*

264. *Id.*

265. For a succinct description of the tradeoff, see *id.* at 131–32 & fig.2.

266. *See* BENKLER, *supra* note 215, at 37–38 ("The other crucial quirkiness is that information is both input and output of its own production process."); FRISCHMANN, *supra* note 164, at 270–75.

267. *See supra* note 31 and accompanying text.

268. *See, e.g.*, Lemley, *supra* note 29, at 1060–62 (detailing five categories of costs of intellectual property rights); Merges & Nelson, *supra* note 61, at 870 (arguing that broad patents could discourage much useful future innovation).

269. Arrow, *supra* note 1, at 620.

270. *See generally* CLAYTON M. CHRISTENSEN, THE INNOVATOR'S DILEMMA: WHEN NEW TECHNOLOGIES CAUSE GREAT FIRMS TO FAIL (1997). There is significant controversy in the literature over the question whether monopoly or competition better spurs innovation. There is significant evidence, however, that competition works better in industries marked by significant cumulative innovation. *See, e.g.*, Merges & Nelson, *supra* note 61, at 884–97 (discussing the impact of competition or lack thereof on industries with cumulative innovation).

271. Lemley, *supra* note 29, at 1042.

272. *Id.* at 1060.

273. *See* Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, *in* 1 INNOVATION POLICY AND THE ECONOMY 119, 121 (Adam B. Jaffe et al. eds.,

thought to arise in biotechnology.[274] Relatedly, when patent claims are broad, multiple patents may purport to cover the technology, giving rise to a "patent thicket."[275]

Importantly for the purposes of this study, the magnitude of dynamic social welfare losses is likely to be particularly high when intellectual property protection is conferred upon early-stage innovations or ideas. That is because such early-stage products are much more likely to be inputs into downstream research.[276] They are therefore more susceptible to the pathologies described above. Perhaps unsurprisingly, then, intellectual property traditionally has declined to protect mere ideas.[277] Bar-Gill and Parchomovsky make a strong case against departing from that tradition, arguing that the costs of doing so far outweigh the potential benefits.[278]

Of course, the policy tools other than intellectual property have their own social welfare profiles as well. For present purposes the benefits may be assumed to be roughly similar—reducing the transaction costs of exchanging information. From a static perspective, each of the mechanisms described in subparts II(A) and II(B) involve some restriction on the availability of information that would otherwise be priced at marginal cost,[279] and each entails some dynamic cost to the extent that information is not freely available for use as an input. That is, the quid pro quo of the patent system requires publicizing the protected information rather than keeping it secret. Private ordering may result in less information ultimately in the public domain.[280] The costs of implementing and administering the mechanisms

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2001) (highlighting the dangers of many broad patents to innovation as companies may encounter difficulties when attempting to invent around existing patents).

274. *See* Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anti-commons in Biomedical Research*, 280 SCIENCE 698, 698 (1998) (discussing the dangers when "multiple owners each have a right to exclude others from a scarce resource and no one has an effective privilege of use").

275. *See* Shapiro, *supra* note 273, at 120 (discussing the creation of a "dense web of over-lapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology").

276. *See* Bar-Gill & Parchomovsky, *supra* note 39, at 409–10.

277. *Id.* at 404 ("[P]atent law traditionally did not afford protection to mere ideas . . . .").

278. *See id.* at 408–12 (arguing that protection of mere ideas will result in a reduction in idea development because idea conceivers will have too much bargaining power).

279. A separate objection to the increased use of private ordering is that it effectively allows protection beyond the scope of congressionally authorized patent and copyright systems. But the law has long enabled protection beyond the scope of congressional legislation. *See generally* Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470 (1974) (discussing the states' power to enact intellectual property laws and regulations so long as they are not in conflict with the operation of laws passed by Congress).

280. *See* Fromer, *supra* note 178, at 581 (arguing that rules on how courts interpret patents incentivize patentees to write unhelpful descriptions which maximize the scope of the patent at the expense of effectively conveying technical information). *But see* Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law*, 87 N.C. L. REV. 1421, 1440–58 (2009) (arguing that this is unlikely to be a significant concern because independent invention rather than copying is the primary driver of patent infringement litigation).

described above may in some circumstances be higher—at least as to the particular parties involved, if not to the public more broadly—than the costs of complying with positive law intellectual property systems. There is reason to believe, however, that the dynamic social welfare costs of the non-property mechanisms described in Part II will be lower than those of traditional intellectual property regimes. That is because exclusive rights regimes like the patent system assign a right to the invention that operates to preclude independent invention. It is a right as against the world. The protection conferred by the other mechanisms, by contrast, operates solely in the context of a commercial relationship.

B. Dynamic Interactions

Further complicating the social welfare analysis is the fact that the phenomena and solutions described in Part II are likely to interact in complex ways. To the extent, for example, that the availability of patent protection is curtailed, this may lead inventors to favor less self-disclosing forms of knowledge codification.[281] Contrariwise, strengthening the alternatives available to inventors may detract from the attractiveness of the patent system.

That basic dynamic varies with the nature of the information that the parties seek to exchange. The choice between information-flow design and patent protection, for example, depends heavily on how easy or hard it is to engage in information-flow design. To the extent that the degree of disclosure on the face of a particular product is less endogenous—less easily controlled, that is, by the information holder—then inventors' incentive likely is to design for less disclosure wherever feasible and then rely on the patent system when they are faced with no other choice.[282]

But there is another aspect to information-flow design to consider—homogeneity. As described above, the heterogeneity of information means that information flow can be self-consciously manipulated even when the underlying asset is self-disclosing. This is one of the central insights of the pharmaceutical example—despite the highly self-disclosing nature of the molecule, the parties generated information *about* the molecule that enabled them to engage in staged negotiations without full disclosure. Finally, consider that intellectual property can be layered into this scheme as well. The molecule in the pharmaceutical example was protected by patent, though the patents appeared to play little part in the information exchange.[283] Of

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281. *Cf.* J. Jonas Anderson, *Secret Inventions*, 26 BERKELEY TECH. L.J. 917, 960–69 (2011) (developing a framework for evaluating the choice between trade secrecy and patents); Lemley, *supra* note 111, at 340–41 (describing the influence of legal rules on the choice between patent and trade secret protection).

282. Available empirical evidence suggests that this is in fact the case. *See* Cohen et al., *supra* note 32, at 13–14; Levin et al., *supra* note 32, at 805.

283. *See supra* notes 171–73 and accompanying text.

course, the patent in that example likely served other purposes,[284] but it is not hard to imagine a scenario where patent protection operates as an overlay on a system of partial information disclosure or other private ordering. In that circumstance, all of the social costs of both intellectual property and the non-property mechanisms may be incurred without a similar doubling up of social benefits.

Part of the difficulty in sorting out these effects is that, as the examples described above demonstrate, it is unclear whether intellectual property protection and non-property-based mechanisms are acting as complements, substitutes, or duplicates. In some circumstances, the various mechanisms work in concert to produce exchange.[285] Examples of this dynamic include the use of tacit information combined with contracting for deeper teaching and exchange in platform technology deals, or the complementarity of contracts and norms in pharmaceutical development. Sometimes they may act as economic substitutes, as when a highly self-disclosing product for which other information-flow design is unavailable forces a choice between patents and secrecy. But sometimes these mechanisms may simply be layered on one another with little additional social benefit. That latter circumstance is of particular concern with respect to proposals to introduce intellectual property into areas where it does not currently apply on the ground that doing so will increase the efficiency of transactions in that area. If the parties operating in the relevant field of innovation have already developed mechanisms for exchange, and they continue to utilize those mechanisms in addition to securing intellectual property protection, then welfare loss is highly likely.

C. The Need for Empirical Research

As the analysis above demonstrates, the conditions under which one or another mechanism for overcoming the disclosure paradox is optimal are likely to vary significantly with the specific circumstances of the information exchange. The complexity of the social welfare analysis should make clear the necessity of further empirical research into the mechanisms that parties use to accomplish transactions in information. In this Article, I have outlined a framework for thinking through the various mechanisms that parties might use to facilitate the exchange of valuable information and have populated that framework with examples to demonstrate that these mechanisms actually are utilized in at least some cases. But in order to evaluate which mechanisms might be more favorable than others in particular circumstances—and in

284. *See supra* notes 253, 255.

285. *See, e.g.*, Jonathan M. Barnett, *The Illusion of the Commons*, 25 BERKELEY TECH. L. J. 1751, 1795–96 (2010) (explaining that historic guilds were successful in generating low transaction cost exchanges of information by denying intellectual property rights at the member level, while continuing to facilitate innovation because of the exclusive intellectual property rights received at the group level).

order to evaluate potential policy interventions—more data is needed about the way that information exchange works and the prevalence and frequency with which information holders make use of the various alternatives available to them.[286]

Existing empirical work provides some clues. In industry surveys, several economists have concluded that patents play a lesser role in appropriating the gains from research and development than do first-mover advantages, ownership of complementary assets, and other such mechanisms.[287] The more recent Berkeley Patent Study points in a slightly different direction.[288] In that survey of entrepreneurs, the authors found that although patents provide mixed to weak incentives to engage in innovation, they often help start-ups to secure financing.[289] Importantly, however, they find that patents link ideas to capital not by overcoming the disclosure paradox, but by providing potential funders with an appropriable asset in industries like biotech where patents are particularly important[290] or by providing signals about the quality of the company's management or technology portfolio.[291] The Berkeley study nevertheless finds that the importance of patents to attracting startup capital varies by industry,[292] and that in at least some industries "patenting may not be a necessary condition for access to entrepreneurial capital."[293] Ronald Mann, in a qualitative study of the software industry, finds that patent protection is usually not important in early-stage financing decisions, but takes on greater importance in later-stage companies.[294] This suggests that the risk of appropriation in early-stage software deals is sufficiently small that the disclosure paradox can be overcome without intellectual property.

As Lemley points out, it often is difficult to find data on the role that intellectual property plays in the processes of technology transfer and

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286. *Accord* Lemley, *supra* note 4, at 748 (acknowledging "licensing rationale for patent law" but concluding that "whether it is true is ultimately an empirical question").

287. *See generally* COHEN ET AL., *supra* note 32; Levin et al., *supra* note 32.

288. Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Study*, 24 BERKELEY TECH. L.J. 1255 (2009).

289. *See id.* at 1303–08 ("[I]nvestors of many types value patents as an input into their investment decision.").

290. *See id.* at 1305 ("A reason why patents are so important in the biotechnology industry in particular is that, when one makes a biotech investment, fundamentally one is making an IP investment.").

291. *See id.* at 1306–07 (reporting that a survey of investors showed that some investors felt patents are a sign of managerial sophistication, while other investors suggested that patents signal quality). This finding is consistent with Clarisa Long's hypothesis that various signaling effects of patents offer another static social welfare benefit. *See generally* Clarisa Long, *Patent Signals*, 69 U. CHI. L. REV. 625 (2002) (discussing the valuable role patents can play as signaling mechanisms and in reducing information costs in capital markets).

292. Graham et al., *supra* note 288, at 1308–09.

293. *Id.* at 1305.

294. Ronald J. Mann, *Do Patents Facilitate Financing in the Software Industry?*, 83 TEXAS L. REV. 961, 981–85 (2005).

licensing.[295] Licensing agreements usually are confidential and, as the discussion above demonstrates, much of information exchange takes place outside of the context of formal contract or legal proceedings.[296] Future research to determine how the complex set of mechanisms and factors described in this Article interact with one another and, therefore, where policy interventions to promote markets for the exchange of information might be fruitful, must necessarily be qualitative in nature. This Article therefore provides a useful framework for case studies and qualitative interview-based work that will follow.[297]

Conclusion

Robust markets for the exchange of information are a critical driver of innovation and economic growth. For ideas to benefit society, they must be developed and commercialzed. And in order for development and commercialization to take place, ideas must be linked with sources of capital and skills. In this Article, I have demonstrated that intellectual property is not necessary to forge those links. Instead, the complex nature of information goods gives rise to a host of strategies that, used alone or in combination, enable the exchange of commercially significant information. Given the potentially high costs of intellectual property, this complexity counsels against reflexive strengthening of existing intellectual property regimes to facilitate commercialization. Instead, policy interventions that seek to promote transactions in information must be made with a more complete understanding of both the social welfare trade-offs involved in different strategies and the specific business and legal environments in which information transactions take place. Reaching that understanding is fundamentally an empirical endeavor that I reserve for future work.

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295. Lemley, *supra* note 4, at 748.

296. *Id.*

297. *Cf.* Michael J. Madison et al., *Constructing Commons in the Cultural Environment*, 95 CORNELL L. REV. 657 (2010) (offering a framework for qualitative research into cultural commons).