ARTICLE

LAW AND THE BOUNDARIES OF TECHNOLOGY-INTENSIVE FIRMS

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The boundaries of technology-intensive firms are determined not only by economic considerations, but also by legal constraints. The law plays a dual role: First, by granting property right protection to certain types of information and withholding such protection from others, the law determines which innovations will be organized under a property-rights-based model and which will be organized by means of access control and restrictions on employee mobility. When information is protected by property rights, the optimal organization of innovation answers the question, "Who should own the innovation?" When information is not protected by property rights, this basic question becomes meaningless, and other sources of control—like access to the innovation and contractual restrictions on employee mobility—come to the fore. This brings us

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to the second role that law plays in drawing the boundaries of technology-intensive firms. In the absence of property rights in the innovation, covenants not to compete (CNCs) become critical in determining incentives and overall efficiency. The law imposes substantial restrictions on the scope and substance of CNCs. In some cases it is legal doctrine, rather than economic considerations, that determines the organization of innovation.

INTRODUCTION

The theory of the firm asks when an intermediate good should be produced in-house and when it should be purchased on the market from an upstream supplier. In technology-intensive industries, one of the central intermediate goods is information or innovation. The question thus becomes which stages of the inventive process should be integrated in a single firm and which should be divided among different firms and traded on the market. The theoretical investigation of the optimal boundary between firm and market cannot be carried out in a legal vacuum. Ideally, only economic considerations should affect the "make or buy" decision. In practice, however, law imposes an important constraint on the economic balance between firms and markets.

We focus on the property rights theory of the firm pioneered by Sanford Grossman, Oliver Hart, and John Moore[1] and applied to the innovation context by Philippe Aghion and Jean Tirole.[2] Aghion and Tirole show both when integration is efficient and when nonintegration is efficient. Their analysis realistically assumes that "the exact nature of the innovation is ill-defined ex ante and the two parties cannot contract for delivery of a specific innovation."[3] But Aghion and Tirole also assume that the contract can specify "the allocation of the *property right* on any forthcoming innovation."[4]

Implicit in Aghion and Tirole's framework is the notion that property rights in the innovation are legally recognized. Is it necessarily the case that innovation is protected by property rights? The assumption that property rights in the intermediate good are legally recognized is, in many contexts, completely innocuous. Obviously, the law recognizes property rights in the proverbial widget. But this key assumption is not innocuous in the innovation context. Legal

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[1] *See generally* OLIVER HART, FIRMS, CONTRACTS, AND FINANCIAL STRUCTURE (1995); Sanford J. Grossman & Oliver D. Hart, *The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration*, 94 J. POL. ECON. 691 (1986); Oliver Hart & John Moore, *Property Rights and the Nature of the Firm*, 98 J. POL. ECON. 1119 (1990).

[2] Philippe Aghion & Jean Tirole, *The Management of Innovation*, 109 Q.J. ECON. 1185 (1994). The property rights theory is not the only possible framework for studying the boundaries of technology-intensive firms. Early contributions in the tradition of Transaction Cost Economics (TCE) include OLIVER E. WILLIAMSON, MARKETS AND HIERARCHIES 127-28 (1975), which pioneered and developed TCE theory that focuses on the ex post bureaucracy costs of integration; David J. Teece, *Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RES. POL'Y 285, 288-96 (1986) [hereinafter Teece, *Profiting from Technological Innovation*], who argued that when innovation is easy, a firm's ability to profit from innovation may depend on its ability to control assets complementary to innovations, such as manufacturing or distribution; and David J. Teece, *Technological Change and the Nature of the Firm*, *in* TECHNICAL CHANGE AND ECONOMIC THEORY 256, 256-81 (Giovanni Dosi et al. eds., 1988) [hereinafter Teece, *Technological Change*]. The importance of appropriability and its relationship with intellectual property rights was first emphasized in Teece, *Profiting from Technological Innovation*, *supra*, at 287. Arora et al. highlight the difficulty in contracting over tacit knowledge and know-how, noting "the role of patents in facilitating transactions in technology." ASHISH ARORA ET AL., MARKETS FOR TECHNOLOGY: THE ECONOMICS OF INNOVATION AND CORPORATE STRATEGY 262 (2001). Scott Masten provides a detailed account of the distinct features of the legal rules governing the employment relationship of firms. *See* Scott E. Masten, *A Legal Basis for the Firm*, 4 J.L. ECON. & ORG. 181, 185-89 (1988) (noting the duties, obligations, sanctions, and procedures under such legal rules).

[3] Aighon & Tirole, *supra* note 2, at 1186.

[4] *Id.* at 1189.

doctrine is continuously struggling to define what classes of information are worthy of property right protection.[5]

This is not to say that most types of innovation are not legally protected. Probably most types of economically valuable innovation are protected by property rights. Accordingly, Aghion and Tirole's model clearly covers a broad class of cases. But, we argue, there is another class of cases that the Aghion and Tirole model does not cover—cases where the innovation is not protected by property rights. Aghion and Tirole derived the optimal organization of innovation, assuming legally recognized property rights in the innovation. How would innovation be organized absent such property rights? We answer this question, emphasizing the differences between the organization of innovation with and without property rights. These differences underscore the important effect of legal policy—which determines the scope of property right protection—on the organization of innovation.[6]

To study the organization of innovation in the absence of property rights, we revert back to the notion of control that underlies the

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[5] *See infra* Part II.

[6] While Aghion & Tirole, *supra* note 2, and the literature that builds on their analysis assume that the innovation is protected by property rights, another strand in the literature adopts the opposite assumption. These authors and others recognize that property rights in information are often imperfect or even nonexistent, and proceed to study how the innovator can extract value from a downstream customer in the absence of property rights. *See* 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) [hereinafter Anton & Yao, *Expropriation and Inventions*] (arguing that despite the risk of expropriation, a financially weak independent inventor selling an invention for which no property rights exist can nonetheless appropriate a sizable share of the market value of the invention by revealing the invention to an informed buyer); James J. Anton & Dennis A. Yao, *Start-Ups, Spin-Offs, and Internal Projects*, 11 J.L. ECON. & ORG. 362, 363 (1995) [hereinafter Anton & Yao, *Start-Ups*] (examining the "incentive conflict" facing an employee who discovers a private innovation for which no property rights exist and must choose between keeping the innovation private or disclosing the innovation to the employer); Joshua S. Gans & Scott Stern, *The Product Market and the Market for "Ideas": Commercialization Strategies for Technology Entrepreneurs*, 32 RES. POL'Y 333, 348 (2003) (finding that "when weak intellectual property for innovation exists alongside low barriers to entry, competitive commercialization strategies are more likely"); Mariagiovanna Baccara & Ronny Razin, *Curb Your Innovation: Corporate Conservatism in the Presence of Imperfect Intellectual Property Rights* 11-20 (Ctr. for Econ. Policy Research, Discussion Paper No. 4466, 2004), *available at* http://www.cepr.org/pubs/dps/DP4466.asp (considering the same spin-off-or-disclose dilemma facing employees creating innovations with imperfect property rights examined in Anton & Yao, *Start-Ups*, *supra*, and examining the effects of various employer attributes on the efficiency of spinning-off or disclosing). These papers, however, do not ask the "boundaries of the firm" question (at least not within the framework of the property rights theory of the firm).

property rights theory of the firm. We argue that control can exist, and be allocated, even absent property rights. We focus on two alternative sources of control: access to the innovation and contractual restrictions on employee mobility.

The first, nonproperty source of control is access to the innovation.[7] We define "nonintegration" as the case where the research unit can withhold knowledge of the innovation from the customer, and "integration" as the case where the existence and substance of the innovation are known by both the research unit and the customer. Under our definitions of access-based organization, the research unit may enjoy control via exclusive access in the nonintegration case. The real power that access provides is determined by the choices available to the research unit. Specifically, can the research unit (*RU*) extract surplus from the customer (*C*) without relinquishing control—that is, without disclosing the innovation to the customer?[8]

In many cases the answer is no. If *RU* cannot develop the innovation itself and must sell it to a customer, then the two parties engage in bargaining under asymmetric information—bargaining that may

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[7] *But see* Raghuram G. Rajan & Luigi Zingales, *The Firm as a Dedicated Hierarchy: A Theory of the Origins and Growth of Firms*, 116 Q.J. ECON. 805, 841 (2001) [hereinafter Rajan & Zingales, *The Firm as a Dedicated Hierarchy*] (defining control as "the right to determine current access," as compared to ownership, "which gives the owner the right to determine access now and in the future"). Rajan and Zingales observe that the Grossman-Hart-Moore Property Rights Theory "does not deem current access necessary in any way (ownership is important only in that it helps control future access)." *Id.* We are not the first to study the role of access in a theory of the firm that is founded on notions of contractual incompleteness and control. Rajan and Zingales emphasize the role of access in organizational design. *See id.* at 813, 841 (focusing on access as a mechanism for allocating power within a firm); Raghuram G. Rajan & Luigi Zingales, *Power in a Theory of the Firm*, 113 Q.J. ECON. 387, 388 (1998); *see also* Krishnamurthy Subramanian, A Theory of Financing of Ideas 3-5 (July 2007) (unpublished manuscript, on file with authors) (focusing specifically on modeling access to ideas). The notion of access adopted in this paper also relates to the notion of real authority developed by Aghion and Tirole. *See* Philippe Aghion & Jean Tirole, *Formal and Real Authority in Organizations*, 105 J. POL. ECON. 1, 2 (1997) (describing real authority as "an effective control over decisions"). Hvide relates organizational structure to the employer's knowledge about "the progress and content of the projects the workers are engaged in," arguing that in smaller firms the employer is better informed; the employer's knowledge depends on access as determined by the organizational structure or firm size. Hans K. Hvide, *The Quality of Entrepreneurs*, 119 ECON. J. (forthcoming 2009) (manuscript at 3), *available at* http://ssrn.com/abstract=545144. Gans and Stern refer to secrecy as an informal appropriability mechanism, as compared to formal intellectual property rights. *See* Gans & Stern, *supra* note 6, at 335.

[8] Following Aghion & Tirole, *supra* note 2, at 1186, we call the upstream creator of the information (or the inventor) the "research unit" and the downstream user of the information (who may proceed to develop it further) the "customer."

well result in impasse. As Kenneth Arrow famously observed, information that is not afforded legal protection cannot be bought or sold on the market. 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.[9]

Faced with the disclosure paradox, often the best that *RU* can do is disclose the innovation to *C*, free of charge, and then bargain under conditions of symmetric information. As Anton and Yao show, *RU* may still be able to extract a significant portion of the surplus from *C* even after disclosing the innovation to *C* by threatening to disclose the innovation to *C*'s competitors.[10] Since the best strategy for *RU* is to disclose the innovation to *C*, the fact that *RU* initially enjoyed exclusive access to the innovation is meaningless, and the distinction between integration and nonintegration collapses.

There are circumstances, however, where access does imply actual control and can thus provide a basis for a theory of organizational design. First, there are cases where *RU* will choose to negotiate with *C* before disclosing the innovation despite the disclosure paradox.[11] Second, when *RU* can develop the innovation itself,[12] access improves *RU*'s bargaining position and thus implies control. Third, in some cases, *RU* can disclose only part of the innovation to *C* and then bargain with *C* for a share of the surplus larger than what it could obtain

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[9] Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY 609, 615 (Nat'l Bureau of Econ. Research ed., 1962) ("In the absence of special legal protection, the owner cannot . . . simply sell information on the open market. Any one purchaser can destroy the monopoly, since he can reproduce the information at little or no cost."); *see also* Anton & Yao, *Expropriation and Inventions*, *supra* note 6, at 191 ("[I]f the inventor first reveals information regarding the invention, a lack of property rights makes it possible for the newly informed party to 'steal' or 'expropriate' the invention.").

[10] Anton & Yao, *Expropriation and Inventions*, *supra* note 6, at 192 (arguing that a contract between *RU* and *C* may be negotiated at this point to garner benefits); *see also* Baccara & Razin, *supra* note 6, at 1-4 (discussing possible choices and outcomes for *RU*).

[11] *See* Anton & Yao, *Expropriation and Inventions*, *supra* note 6, at 191 (noting that an inventor could negotiate without disclosing the innovation, but buyers are understandably "hesitant to buy . . . an unknown commodity").

[12] *See* Anton & Yao, *Start-Ups*, *supra* note 6, at 363 (noting that an employee who develops a reproducible innovation can leave the firm and start a new company); *see also* Gans & Stern, *supra* note 6, at 336 (observing that an innovator's profitability depends, in part, on her ability to establish market presence).

after full disclosure.[13] Finally, in some cases *RU* can leverage access and force *C* to sign a nondisclosure agreement (NDA).

We characterize the optimal access-based organization of innovation and compare social welfare under access-based organization with welfare when property rights in the innovation are recognized and the organization of innovation can be based on the allocation of these property rights. We show that the organization of innovation, and its welfare consequences, depends on the legal policy that sets the scope of intellectual property rights.

The second, nonproperty source of control derives from contractual restrictions on employee mobility or covenants not to compete (CNCs). CNCs are easy for courts to enforce even in an environment fraught with noncontractibility (like the innovation environment). Oliver Hart observed that in technology-intensive industries, the firm's "source of value may consist of as little as . . . a contract that prohibits [the firm's] workers from working for competitors."[14]

Nonhuman assets are the source of control in the property rights theory. The emphasis on nonhuman assets is motivated by "the absence of slavery,"[15] which implies that control over human assets is inalienable and thus cannot be allocated. The important role of CNCs, as recognized by Hart, suggests that, at least in technology-intensive sectors, nonhuman assets are not the only, and perhaps not the main, source of control. Control over human assets can be allocated. Of course, the reach of CNCs is limited. And it is the law that sets the limit, taking into consideration, among other things, the inalienability concerns raised by Hart.

CNCs differ from the standard assets that serve as a source of control in yet another way. The standard assets are discrete. A machine is either owned by *A* or by *B*.[16] CNCs, on the other hand, allocate control in a continuous manner. The strength of a CNC depends on its geographical and temporal reach—both continuous dimensions.

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[13] *See* James J. Anton & Dennis A. Yao, *The Sale of Ideas: Strategic Disclosure, Property Rights, and Contracting*, 69 REV. ECON. STUD. 513, 514-15 (2002) (describing how, in competitive markets, partial disclosure can drive up an innovator's profits).

[14] HART, *supra* note 1, at 57.

[15] *Id.* at 29.

[16] Joint ownership is also possible. Joint ownership may seem to allow for a continuous allocation of control, similar to the type that we attributed to CNCs. *See infra* text accompanying notes 54-56. The ownership shares can be continuous: *A* can own X% and *B* can own $(100 - X)$%. But these continuous-ownership shares do not translate into a continuous allocation of control: either one party has decision rights or each party has veto power.

Stronger CNCs increase the customer's control and thus enhance her incentives to invest. At the extreme, a very powerful CNC can mimic the incentives generated when the innovation is protected by property rights and these rights are allocated to *C* (the integration case).[17] A CNC, as a continuous contracting variable, allows the parties to optimally calibrate incentives, at least within certain bounds.[18]

As suggested above, one such bound is defined by the law. The law imposes an upper bound on the strength of enforceable CNCs. When the marginal efficiency of the customer's investment is small enough relative to that of the research unit's investment, this constraint is not binding. But when the marginal efficiency of the customer's investment is large enough relative to that of the research unit's investment, this legal constraint is binding. In these cases, the organization of innovation is determined by legal, not economic, considerations.[19]

The law thus plays a dual role. First, by setting the scope of property right protection, it selects between property-based organization of innovation and CNC-based organization of innovation. We emphasize the differences between these two forms of organization and the welfare consequences of these differences. Second, when one arm of the law precludes property-based organization, a second arm of the law determines, in some cases, the specific organizational structure by limiting the range of enforceable CNCs.

The burden of this paper is to identify and begin to explore the central role that the law plays in setting the boundaries of technology-

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[17] At the other extreme, a very weak noncompete clause brings us back to the outcome described in the case where the innovation is not legally protected. The employee's incentives to invest in this scenario can be very weak (depending on the effect of the employee's threat to leave and go work for a competitor). In particular, while we associate weak noncompete clauses with nonintegration, the incentives that such nonintegration provides for employees can be much weaker than the incentives provided to employees when the innovation is protected by property rights and these rights are allocated to the employee (as in the nonintegration case).

[18] *Cf.* Eric A. Posner et al., *Investing in Human Capital: The Efficiency of Covenants Not to Compete* 3 (Univ. of Va. Law Sch., John M. Olin Program in Law and Econ. Working Paper Series, Working Paper No. 11, 2004), *available at* http://law.bepress.com/uvalwps/olin/art11 (arguing that the scope of the CNC is set to induce privately, but not socially, optimal incentives to invest in human capital).

[19] As described *infra* Part II, successful innovation can occur in the absence of enforceable CNCs. The prime example is the success of Silicon Valley despite the refusal of California law to enforce CNCs. In certain cases (or places) there may be other forces outside of our model that enable efficient innovation absent CNCs. This observation, however, does not undermine our analysis. In many other cases (or places), CNCs are important and the law's restrictions on CNCs affect the organization of innovation.

intensive firms. As suggested above, the law plays a dual role: First, once we realize that property rights in innovation should not be taken for granted, it becomes clear that the legal determination of which categories of information will be protected by property rights has a direct effect on the boundaries of the firm question. Specifically, the basic question "who should own the innovation?" becomes meaningless, and other sources of control, like access to the innovation and contractual restrictions on employee mobility, come to the fore. This brings us to the second role that law plays in drawing the boundaries of technology-intensive firms. In the absence of property rights in the innovation, CNCs become critical in determining incentives and overall efficiency. The law imposes substantial restrictions on the scope and substance of CNCs. In some cases these legal constraints, rather than economic considerations, determine the strength of the CNC and thus the organization of innovation.

In addition to the various strands of literature surveyed above, this paper relates to several recent contributions exploring the role of law, and specifically the role of intellectual property rights (IPRs), in setting the boundaries of technology-intensive firms. Arora and Merges argue that stronger IPRs contribute to the viability of small, specialized firms, and thus favor independent suppliers over vertical integration.[20] Arora and Merges, however, "neglect[] the possibility that a captive supplier could quit the parent firm and join a rival [or start a new firm]."[21] We incorporate this possibility in our analysis, and we thus reach more nuanced conclusions about the relationship between IPRs and firm boundaries.[22]

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[20] Ashish Arora & Robert P. Merges, *Specialized Supply Firms, Property Rights and Firm Boundaries*, 13 INDUS. & CORP. CHANGE 451, 451 (2004); *see also* Ashish Arora & Alfonso Gambardella, *The Changing Technology of Technological Change: General and Abstract Knowledge and the Division of Innovative Labour*, 23 RES. POL'Y 523, 529 n.13 (1994) (noting that strong intellectual property rights have encouraged specialization in fields such as biotechnology); Robert P. Merges, Intellectual Property Rights, Input Markets, and the Value of Intangible Assets 3-4 (Feb. 9, 1999) (unpublished manuscript), *available at* http://www.law.berkeley.edu/institutes/bclt/pubs/merges/iprights.pdf (calling IPRs the "crown jewels" of small firms).

[21] Arora & Merges, *supra* note 20, at 456.

[22] Also, much of the analysis in Arora & Merges, *supra* note 20, can be interpreted as proposing one way to minimize the costs associated with the disclosure paradox—through intellectual property rights in complementary assets. *See also* ARORA ET AL., *supra* note 2, at 116-17 (noting that an innovator can protect herself by withholding the "know-how" of complementary technology). Our focus, on the other hand, is on intellectual property rights in core informational assets.

Burk and McDonnell offer a detailed account of how different doctrines of intellectual property law affect the relative costs of integration and nonintegration.[23] Their main argument is that the law should avoid excessively strong IPRs.[24] This conclusion follows from their assumption about the stickiness of IPRs. Specifically, they assume that if the law initially allocates strong property rights to *C*, it will be costly to reallocate these rights (or some of them) to *RU*.[25] Without denying that the reallocation of property rights may be costly, we believe that it is useful to begin with the benchmark assumption, adopted in much of the property rights literature, that if the law recognizes property rights in the innovation, the cost of allocating or reallocating these rights between the parties is low.

The remainder of this paper is organized as follows: Part I studies the organization of innovation absent legally recognized property rights, and demonstrates the important role that law plays in setting the boundaries of technology-intensive firms. Part II provides a brief and selective summary of the relevant legal doctrines. We begin by surveying the law that determines the range of innovations that are afforded property right protection and can thus be organized based on the allocation of these property rights. We then describe the law governing CNCs, which, as explained above, determines, in some cases, the specific organizational structure. A brief conclusion follows.

I. ORGANIZING INNOVATION WITHOUT PROPERTY RIGHTS

The organization of innovation depends on whether the law recognizes property rights in the innovation. Some categories of innovation enjoy property right protection, while others do not. Since Aghion and Tirole have studied the organization of innovation under the assumption that property rights in innovation are legally recognized,[26] we focus on those categories of innovation that do not enjoy property right protection.[27]

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[23] 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.

[24] *Id.* at 577.

[25] *Id.* at 597-600.

[26] Aghion & Tirole, *supra* note 2, at 1186-87 (noting the focus on the legal features of research and development).

[27] In some cases assets complementary to the unprotected innovation are legally protected. These assets can be used both conceptually—to define the boundaries of the firm—and substantively as a means for *RU* to extract surplus from *C*. *See, e.g.*, Arora & Merges, *supra* note 20, at 453 (calling complementary assets a "safeguard"); Teece,

A. *Framework of Analysis*

We adopt the basic structure of the Aghion and Tirole model.[28] *RU* performs research for *C*. The expected value of the innovation for the customer (i.e., the probability of discovery multiplied by the value of the innovation conditional upon discovery), $V(e, E) > 0$, depends on the noncontractible investment e by *RU* and on the noncontractible investment E by *C*. The exact nature of the innovation (i.e., the product of *RU*'s efforts) is ill defined ex ante and thus noncontractible.

The ex ante noncontractibility implies that incentives to invest will be determined by the ex post division of the surplus $V(e, E)$ between the two parties. Let $\alpha \in [0,1]$ denote the share of ex post surplus that goes to *C*. A higher α implies stronger incentives for *C* and correspondingly weaker incentives for *RU*.

We focus on ex ante efficiency, which depends on the relative efficiency of the parties' investments. Let $\beta \in [0,\infty)$ denote the relative efficiency of the parties' investments, such that a higher β means that *C*'s investments are relatively more efficient as compared to *RU*'s investments. Optimally, when β is higher, α will also be higher in order to provide stronger incentives to *C*, whose investment is more important. And when β is lower, the optimal α will also be lower in order to provide stronger incentives to *RU*, whose investment is more important.

B. *With Property Rights: The Aghion and Tirole Model*

Aghion and Tirole assume that innovation is protected by property rights. In the Aghion and Tirole Model (A-T model), the ex ante contract specifies the allocation of property rights on any forthcoming innovation.[29] Specifically, Aghion and Tirole consider two possible al-

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Profiting from Technological Innovation, *supra* note 2, at 288-91 (describing complementary assets and calling them a "critical" bargaining chip). Following Aghion and Tirole, *supra* note 2, we focus on cases where there are no significant complementary assets.

[28] Aghion & Tirole, *supra* note 2, at 1186-87. We present a bare-bones version of the Aghion and Tirole model, abstracting from many important features of their model. We generalize the Aghion and Tirole model in one dimension in particular: while Aghion and Tirole assume that the value of the innovation V is exogenous, we allow V to depend on the parties' investments. This generalization helps demonstrate the effect of organizational structure in the absence of property rights in the innovation. *See infra* subsection II.A.5.

[29] That is the only relevant factor in the contract. The contract can also specify a sharing rule on the verifiable revenue (license fee) obtained by the research unit, but Aghion and Tirole demonstrate that the sharing rule is irrelevant. *See* Aghion & Tirole, *supra* note 2, at 1193; *see also* HART, *supra* note 1, at 79 (observing that revenue- or cost-sharing contracts do not force either party to trade under the contract).

locations: (1) *C-ownership* or *integration*, where the property rights on the innovation are allocated to *C*, and (2) *RU-ownership* or *nonintegration*, where the property rights on the innovation are allocated to *RU*.

They show that under integration, *C*'s expected payoff is $V(e, E)$ and *RU*'s expected payoff is 0.[30] Under nonintegration, both *C*'s and *RU*'s expected payoffs are $\frac{1}{2} \times V(e, E)$. With property rights in the innovation, we have $\alpha_P^{Int} = 1$ and $\alpha_P^{NInt} = \frac{1}{2}$, where the *P* subscript denotes the existence of property rights and the superscripts *Int* and *NInt* denote integration and nonintegration, respectively.

C. *Contractible Allocation of Property Rights in a Noncontractible Innovation*

The main goal of this paper is to study the organization of innovation when the innovation is not protected by property rights. Namely, while Aghion and Tirole assume the existence of property rights in innovation, we will adopt the opposite assumption. We will show that innovation will be organized differently with and without property rights. We will then argue that since the law determines what categories of innovation receive property right protection, the law influences the organization of innovation.

Before embarking on an analysis of the optimal organization of innovation without property rights, we consider the consistency of the Aghion and Tirole framework with recognized property rights. Aghion and Tirole assume that the innovation is not contractible. But if "the exact nature of the innovation is ill defined ex ante,"[31] how can the parties allocate property rights in the innovation? In the basic property rights model,[32] the parties allocate property rights not in the intermediate good itself but rather in the nonhuman assets used either to produce the intermediate good or to utilize the intermediate good in the production of the final product. There is no contractibility problem with respect to these assets. But when the relevant asset is the intermediate good itself and this good is, by stipulation, noncontractible, why is ownership of this good contractible?

One response is that an ex ante contract can specify that anything created by *RU*—for concreteness, any patents received by *RU*—will be assigned to *C*. But such a contract is not without cost. It may well be

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[30] These are ex post payoffs; to get the ex ante payoffs subtract *E* for *C* and *e* for *RU*.

[31] Aghion and Tirole, *supra* note 2, at 1189.

[32] *See, e.g.*, HART, *supra* note 1, ch. 2 (introducing and explaining the property rights approach to the firm).

the case that *RU* should retain ownership of some of its innovations. More importantly, if the innovation is truly noncontractible, a contract that allocates *RU*'s innovations to *C* can be circumvented. If *RU* learns that a certain innovation will be valuable, it can have the patent registered under a friend's name, thus avoiding the obligation to assign the patent to *C*.[33]

In practice, *RU* will be reluctant to have the patent registered in someone else's name. Either honesty or the desire to get credit for one's innovation may be enough to avoid circumvention of the contract. Reputation can also help police the contract. But these are empirical questions. Aghion and Tirole's theoretical framework relies on a specific answer to these empirical questions.

D. *No Property Rights*

What happens when property rights in the innovation are not legally recognized? The basic question that Aghion and Tirole ask—"Who should own the innovation?"—becomes meaningless. This, in itself, shows the magnitude of the potential impact that the law may have on the boundaries-of-the-firm question. The legal policy decision, whether to recognize property rights in the innovation, determines the contours of the economist's inquiry.

The law's refusal to recognize property rights in the innovation does more than eliminate the who-should-own-the-innovation question. It redefines the organization-of-innovation question. While ownership of the innovation can no longer distinguish between integration and nonintegration, other factors can step in and define the available organizational options.

The property rights theory of the firm assumes that contracts are incomplete and that it is therefore important to allocate control rights to be exercised when the incomplete contract is silent. Ownership is defined by residual control rights.[34] Going back to control as the primitive variable in the property rights theory, is it possible to have control without legally recognized property rights? The answer is yes.

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[33] *Cf. id.* at 79 (arguing that while "the presence of a third party can help" contractibility problems, "there is a great incentive for" the third party to collude with another party); Aghion & Tirole, *supra* note 2, at 1193 (making an argument similar to ours about the irrelevance of the initial sharing rule).

[34] *See* HART, *supra* note 1, at 29-30 (defining residual-control rights as "the right to decide all usages of the asset in any way not inconsistent with a prior contract, custom, or law").

We explore two sources of control: access to the innovation and contractual restraints on employee mobility.[35]

1. Access to the Innovation

One source of control, independent of legally enforceable property rights, derives from access to the innovation. The choice between integration and nonintegration can affect this access to the innovation. In fact, absent property rights, we propose defining the organizational form in terms of access. Specifically, we define nonintegration as the case where *RU* has exclusive access to the innovation and can withhold knowledge of the innovation from *C*. We define integration as the case where the existence and substance of the innovation are known by both *RU* and *C*.

Under integration, we posit, any innovation produced by *RU* is accessible to *C*.[36] Still, since *C* does not have property rights in the innovation, *RU* can disclose the innovation to *C*'s competitors.[37] *RU* will use the threat of disclosure to extract higher wages.

Consider the following simple model, which is a reduced-form version of the Anton and Yao model.[38] The value of the innovation to *C* is $V(e, E)$, assuming that *C*'s competitors do not have access to the innovation. If *RU* discloses the innovation to *C*'s competitors, then *C* will enjoy a reduced value of $(1 - \delta) \times V(e, E)$, where $\delta \in [0, 1]$. We assume that in the bargaining between *C* and *RU*, *C* makes a take-it-or-leave-it offer with probability ½ and *RU* also makes a take-it-or-leave-it offer with probability ½. Therefore, *C*'s expected payoff is $\frac{1}{2} \times V(e, E) + \frac{1}{2} \times (1 - \delta) \times V(e, E)$ or $(1 - \frac{1}{2} \times \delta) \times V(e, E)$, and *RU*'s expected payoff is $\frac{1}{2} \times \delta \times V(e, E)$.

Under nonintegration, *RU* can produce the innovation and keep it secret. In other words, *RU* controls the access to the innovation and

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[35] A clarification of terminology is in order. Our purpose is to expound the role of law in drawing the boundaries of the firm. We thus distinguish between legally recognized property rights and other sources of control. We recognize, however, that economists may define "property right" more broadly to coincide with "control." But even under this definition it would be interesting to identify and compare different legal and extralegal sources of control.

[36] The alternative case, where an employee who made a discovery can try to negotiate a wage increase while keeping the discovery secret, is in fact a nonintegration case under our access-based definition of integration and nonintegration.

[37] Alternatively, *RU* can leave the firm and use the innovation herself or start working for one of *C*'s competitors. *See infra* subsection I.D.2.

[38] *See* Anton & Yao, *Expropriation and Inventions*, *supra* note 6, at 192-95.

can withhold access from *C*. But, because the innovation is only valuable in *C*'s hands, *RU* must bargain with *C* in order to extract any value from its investment. And *C* will be reluctant to enter into such negotiations without knowing what *RU* has to sell. The disclosure paradox, if applicable in its extreme form, prevents *RU* from reaping any benefits from its investment, which implies that *RU* will not invest. Similarly, anticipating this impediment to trade, *C* will not invest. The result: no innovation.[39]

But is this extreme no-trade, no-innovation result unavoidable? No. Faced with the prospect of no innovation and a zero surplus, *RU* is better off disclosing the innovation to *C*, free of charge.[40] As suggested by Anton and Yao, even after disclosing the innovation to *C*, *RU* will still be able to extract some surplus from *C* by threatening to disclose the innovation to *C*'s competitors, as in the integration case.[41] Under the nonintegration option, *RU* initially controls access to the innovation, but it will choose to relinquish control. And since this loss of control is anticipated ex ante, the initial allocation of control to *RU* is meaningless. The parties' incentives to invest will be determined only by the value of the innovation to *C*, by the cost to *C* of *RU*'s making good on its threat to disclose the innovation to others, and by the parties' relative bargaining power.[42]

This result implies that organizational structure is irrelevant when property rights innovation can be organized only through access con-

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[39] Models applying the property rights theory, such as the A-T model, generally focus on ex ante efficiency and thus assume frictionless ex post bargaining under conditions of symmetric information. *See* HART, *supra* note 1, at 34, 38. The secrecy forced by the absence of property rights renders this assumption inapplicable. Bargaining under asymmetric information suffers from well-known inefficiencies. At the extreme, the market can completely unravel. Anton and Yao formally show how adverse selection leads to a "vanishingly small" payoff to the inventor when the inventor's wealth is limited. *See* Anton & Yao, *Expropriation and Inventions*, *supra* note 6, at 203. (We follow Aghion and Tirole, *supra* note 2, at 1188, in assuming that *RU* has no initial cash endowment.) But even if the extreme no-trade—and even no-negotiations—outcome can be avoided, the parties will still expect a reduced ex post surplus and will accordingly be more reluctant to invest ex ante.

[40] *See* Anton & Yao, *Expropriation and Inventions*, *supra* note 6, at 195 (noting that "an inventor who has made a difficult but valuable discovery can expect a significant payoff . . . by freely revealing the invention").

[41] *Id.* at 195-96.

[42] *RU*'s threat to disclose in the integration case is identical to *RU*'s threat to disclose in the nonintegration case. The resulting ex post wage adjustment affects the expected payoffs and investment incentives in the same way. *See generally* Anton & Yao, *Start-Ups*, *supra* note 6 (examining the incentives faced by an employer and an employee after the employee privately discovers a significant innovation).

trol. This result, while serving as a useful benchmark, is not the end of the story. The economics literature has devised several mechanisms that would allow *RU* to secure a larger share of the ex post surplus if it is awarded exclusive access to the innovation.[43] First, the disclosure paradox does not necessarily prevent trade. There are cases where *RU* will choose to negotiate with *C* before disclosing the innovation despite the disclosure paradox—specifically when *RU* has significant initial wealth.[44] Second, when *RU* can develop the innovation itself,[45] *C* can no longer assume that *RU* will disclose the innovation to it free of charge and access becomes a source of power affecting the outcome of the ex post bargaining between *C* and *RU*.[46] Third, in some cases *RU* can disclose only part of the innovation to *C* and then bargain with

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[43] Other ways in which *RU* may be able to extract some value from *C*, even absent property rights in the innovation, have been discussed in the literature but are not discussed in this paper. *See* ARORA ET AL., *supra* note 2, at 116 ("[E]fficient contracts . . . can be written by exploiting the complementarity between know-how and any other technology input that the licensor can use as a 'hostage.'"); Teece, *Profiting from Technological Innovation*, *supra* note 2, at 304 (discussing the importance of owning complementary assets for extracting value from the innovation); Lynne G. Zucker et al., *Commercializing Knowledge: University Science, Knowledge Capture, and Firm Performance in Biotechnology*, *in* SCIENCE AND CENTS: EXPLORING THE ECONOMICS OF BIOTECHNOLOGY 149, 151 (John V. Duca & Mine K. Yücel eds., 2002), *available at* http://www.dallasfed.org/research/pubs/science/darby_zucker.pdf (detailing "the strong effects of academic science [in the form of academic-to-industry technology transfers] on the success of firms"); Bruno Biais & Enrico Perotti, Entrepreneurs and New Ideas 5 (Jan. 2006) (unpublished manuscript), *available at* http://ssrn.com/abstract=424601 (discussing how an "entrepreneur can take advantage of the complementarity between the different dimensions of her innovative idea, to mitigate the risk of idea stealing"). Also, in certain contexts innovators are driven by nonpecuniary motives and are thus more willing to share ideas across firm boundaries. *See* LAWRENCE LESSIG, THE FUTURE OF IDEAS 14 (2001) (arguing for the essential importance of free resources); Yochai Benkler, *Coase's Penguin, or, Linux and* The Nature of the Firm, 112 YALE L.J. 369, 374 (2002) (suggesting "characteristics that make large-scale collaborations . . . sustainable and productive in the digitally networked environment without reliance either on markets or managerial hierarchy"). Finally, and perhaps most importantly, reputation—either of the research unit or of the customer—can overcome the disclosure paradox.

[44] *See* Anton & Yao, *Expropriation and Inventions*, *supra* note 6, at 191 (arguing that an inventor is willing to negotiate when she has "large financial resources").

[45] *See* Anton & Yao, *Start-Ups*, *supra* note 6, at 362 (discussing an employee's option, upon making a discovery, to leave his firm and form a start-up); Gans & Stern, *supra* note 6, at 336 (discussing how "a start-up innovator . . . launch[es] its product independently").

[46] Gans and Stern refer to this option as "[p]rofiting from innovation through the market for ideas" and discuss "negotiations . . . in the shadow of *potential* product market competition." Gans & Stern, *supra* note 6, at 336-37. Seventy-one percent of the firms included in the Inc. 500 (a list of young, fast-growing firms) were founded by people who "replicated or modified an idea encountered through [their] previous employment." AMAR V. BHIDÉ, THE ORIGIN AND EVOLUTION OF NEW BUSINESSES 54 (2000).

C for a share of the surplus larger than what it could obtain after full disclosure.[47] Finally, in some cases *RU* can leverage access and force *C* to sign an NDA.[48]

In our benchmark irrelevance result $\alpha_A = 1 - \frac{1}{2} \times \delta$ regardless of the organizational form. When access provides real power to *RU* under nonintegration, $\alpha_A^{NInt} < 1 - \frac{1}{2} \times \delta = \alpha_A$. We assume that $\alpha_A^{NInt} > \frac{1}{2}$. Integration still implies $\alpha_A^{Int} = \alpha_A = 1 - \frac{1}{2} \times \delta$.

Lemma 1 summarizes the organization of innovation with and without property rights as a function of the relative marginal efficiency of the parties' investments.

> *Lemma 1*: Three threshold values $(\beta_1, \beta_2, \beta_3)$, satisfying $\beta_1 < \beta_2 < \beta_3$, divide the parameter range $\beta \in [0, \infty)$, as follows:
>
> (i) When the relative marginal efficiency of *C*'s investment as compared to *RU*'s investment is sufficiently low—i.e., $\beta \leq \beta_1$—efficiency is maximized when the innovation is protected by property rights and these rights are allocated to *RU* (nonintegration). Absent property rights, inefficiency will be minimized by access-based nonintegration.
>
> (ii) When the relative marginal efficiency of *C*'s investment as compared to *RU*'s investment is sufficiently large—i.e., $\beta \geq \beta_3$—efficiency is maximized when the innovation is protected by property rights and these rights are allocated to *C* (integration). Absent property rights, inefficiency will be minimized by access-based integration.
>
> (iii) When the relative marginal efficiency of *C*'s investment as compared to *RU*'s investment is between these two extremes, efficiency is maximized by access-based organization structure. Specifically, access-based nonintegration maximizes efficiency when $\beta \in (\beta_1, \beta_2)$, and access-based integration maximizes efficiency when $\beta \in [\beta_2, \beta_3)$.

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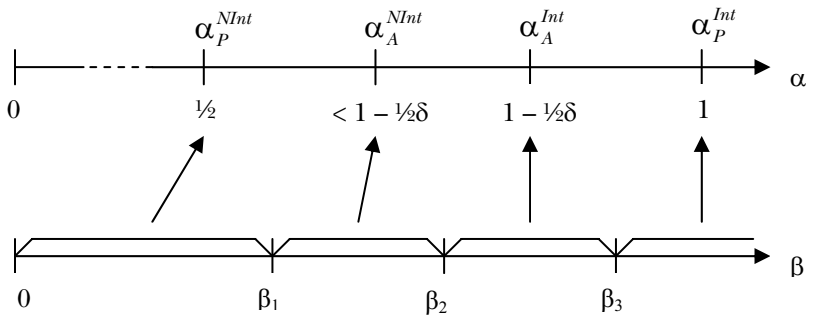
[47] *See* Anton & Yao, *supra* note 13, at 514 (discussing the phenomenon of partial disclosure).

[48] A legally enforceable NDA can be viewed as a substitute for property right protection—i.e., as an alternative mode of legal protection afforded to the innovation. *See infra* subsection I.D.2. In essence, the viability of an NDA implies that the innovation is contractible. Achieving contractibility is costly, perhaps prohibitively so. *RU* would have to invest in detailed documentation of the innovation and *C* would have to invest in detailed documentation of its stock of knowledge in a way that would enable the execution of a nondisclosure agreement.

These results are depicted in Figure 1.

Figure 1



The following proposition states the role of the law in determining the organization of innovation and describes the welfare consequences of a legal policy denying property rights in the innovation, when the alternative to property-based organization is access-based organization:

> *Proposition 1*: When, in the absence of property rights, the organization of innovation is access-based, the legal policy denying property rights in the innovation will replace property-based organization with inefficient access-based organization when $\beta \leq \beta_1$ and when $\beta \geq \beta_3$. When $\beta \in (\beta_1, \beta_3)$, this legal policy will have no effect, as long as the parties can effectively avoid property rights and opt for access-based organization.

Part (iii) of Lemma 1 and Proposition 1 imply that access-based organization may be superior to property-based organization. This does not imply any inefficiency in recognizing property rights in the innovation, as long as the parties can waive these rights in the ex ante contract—i.e., specify that neither party will obtain a property right (e.g., no patent application will be filed). In some cases such a waiver may be impractical or even legally unenforceable. In those cases, part (iii) of Lemma 1 and Proposition 1 provide a reason not to recognize property rights in the innovation.[49]

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[49] Alternatively, if we allow for stochastic property rights, as does, for example, HART, *supra* note 1, at 86, then property rights again can only increase efficiency. But stochastic property rights may also be legally unenforceable.

2. Restraints on Employee Mobility

Another source of control derives from contractual restrictions on employee mobility. We have thus far assumed that the innovation can be readily disclosed to a competitor. This assumption captures one set of cases. In other cases, the innovation cannot be readily conveyed to a competitor. Rather, *RU* must actually work for the competitor or physically relocate to the competitor's plant and engage in hands-on training of the competitor's employees. This type of innovation is sometimes referred to as "know-how."

The know-how case introduces a new contractual possibility. Since the physical movement of employees is verifiable, such movements can be contractually prevented. Indeed firms routinely ask their employees to sign covenants not to compete, prohibiting the employees from working for a competitor for a prescribed period of time. Oliver Hart observed that in technology-intensive industries, "[the firm's] source of value may consist of as little as . . . a contract that prohibits [the firm's] workers from working for competitors."[50]

The property rights theory of the firm emphasizes control that stems from ownership of nonhuman assets. This emphasis on nonhuman assets is motivated by "the absence of slavery."[51] But as described above—and as recognized by Hart—contractual restrictions on employee mobility do exist and can be an important source of control.[52] Of course, the reach of these contractual restrictions and, correspondingly, the extent of control that they provide are not unlimited. And it is the law that sets the limits—limits that echo the slavery concerns raised by Hart.[53]

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[50] *Id.* at 57. Aghion and Tirole discuss trailer clauses, which are closely related to CNCs, yet they retain the assumption that property rights in the innovation are legally recognized. Aghion & Tirole, *supra* note 2, at 1199-1200.

[51] HART, *supra* note 1, at 29.

[52] *Cf.* Sudipto Bhattacharya & Sergei Guriev, *Knowledge Disclosure, Patents, and Optimal Organization of Research and Development* 4 (London Sch. of Econ., Suntory & Toyota Int'l Ctrs. for Econ. & Related Disciplines, Research Paper No. TE/2004/478, 2004), *available at* http://sticerd.lse.ac.uk/dps/te/te478.pdf (describing a situation in which a developing unit's control over a research unit derives from an ex ante contract providing the developing unit with a right to veto the research unit's outside financing choices).

[53] A CNC is not a property right according to Hart's basic definition. He defines property rights as residual-control rights—"the right to decide all usages of the asset." HART, *supra* note 1, at 30. Hart correctly notes that this definition is "consistent with the standard view of ownership [and property rights] adopted by lawyers." *Id.* at 30 n.4. Nevertheless, Hart notes that a CNC may be the defining asset of R&D firms.

A first-cut analysis maps CNCs to organizational structure as follows: integration obtains when *C* hires *RU* and secures control by having *RU* sign a CNC. Conversely, nonintegration obtains when *RU* does not sign a CNC and remains free to relocate to another firm. But this binary characterization is an oversimplification.

A CNC, in terms of the control that it affords to the customer, is a continuous variable.[54] CNCs can vary on several continuous dimensions—specifically, the size of the geographic area in which the employee cannot seek alternative employment and the time period in which the employee is prevented from competing with the customer. In the basic property rights theory of the firm,[55] allocation of control is discrete: a certain nonhuman asset is allocated either to one firm or to another. Continuous allocation of control, as obtained through CNCs, is less conducive to clear demarcation of firm boundaries.[56] Still, as Hart recognizes, a CNC can be the central asset defining a technology-intensive firm, especially when the innovation is not afforded property right protection.

Extending the framework described in Section I.A, let $V(e, E)$ denote the value of the innovation to *C*, if *C*'s competitors do not have access to the innovation. If *RU* leaves *C* and starts working for *C*'s competitor with her knowledge of the innovation, the value of the innovation to *C* is $(1 - \delta) \times V(e, E)$, where $\delta \in [0,1]$. *C* can limit *RU*'s ability to disclose the innovation by enjoining the employee from working for *C*'s competitors. We capture this power through a parameter, $\eta \in [0, 1]$, that measures the strength of the CNC. With a CNC, the value of the innovation to *C* is $(1 - (1 - \eta) \times \delta) \times V(e, E)$. At one extreme, $\eta = 0$, the CNC is powerless, and *C* loses the entire proportion δ if *RU* relocates to *C*'s competitor: $(1 - (1 - \eta) \times \delta) \times V(e, E) = (1 - \delta) \times V(e, E)$. At the other extreme, $\eta = 1$, the CNC is sufficiently strong in terms of its geographic or temporal reach that *C* loses nothing from *RU*'s relocation to a firm outside the geographical boundary

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[54] Imperfect enforcement transforms the allocation of property rights from a discrete to a continuous decision. *See, e.g.*, Arora & Merges, *supra* note 20, at 452-53 (discussing the effects of information spillovers on firms based on different levels of rights protection); Rajan & Zingales, *The Firm as a Dedicated Hierarchy*, *supra* note 7, at 826-28 (discussing the effects of better or worse enforcement on the nature of a firm). But, unlike with CNCs, the continuous variable is not in the parties' control (at least not entirely; the parties can affect the probability of enforcement to some degree).

[55] *See, e.g.*, HART, *supra* note 1, ch. 2 (presenting the property rights model and discussing how the theory influences organizational arrangements).

[56] Imperfect enforcement of property rights can similarly transform a discrete allocation of property rights into a continuous allocation.

of the CNC or after the term of the CNC expires: $(1 - (1 - \eta) \times \delta) \times V(e, E) = V(e, E)$.

C's expected payoff is $(1 - \frac{1}{2} \times (1 - \eta) \times \delta) \times V(e, E)$. *RU*'s expected payoff is $\frac{1}{2} \times (1 - \eta) \times \delta \times V(e, E)$. When the source of control is a CNC, we have $\alpha_{CNC} = 1 - \frac{1}{2} \times (1 - \eta) \times \delta$.

The parties' incentives to invest depend on the strength of the CNC—i.e., on η. At one extreme, when $\eta = 0$, *RU*'s incentives are strongest, but still weaker than her incentives under nonintegration in the A-T model where the innovation is protected by property rights. *C*'s incentives are weakest when $\eta = 0$, but they are still stronger than the incentives generated under nonintegration in the A-T model: $\alpha_{CNC}|_{\eta = 0} = 1 - \frac{1}{2} \times \delta > \frac{1}{2} = \alpha_P^{NInt}$. At the other extreme, when $\eta = 1$, *RU*'s incentives are weakest and *C*'s incentives are strongest. A $\eta = 1$ CNC precisely mimics the outcome obtained under integration in the A-T model. A very powerful CNC provides as much control as a property right: $\alpha_{CNC}|_{\eta = 1} = 1 = \alpha_P^{Int}$.

Enter the law. The law imposes an upper bound, $\overline{\eta} \in (0, 1)$, on the strength of the CNC. A CNC with $\eta > \overline{\eta}$ will not be enforced. When the marginal efficiency of *C*'s investment relative to that of *RU*'s investment is sufficiently small, the legal constraint is not binding. But when the marginal efficiency of *C*'s investment is large enough relative to that of *RU*'s investment, the organizational structure as characterized by the strength of the CNC will be determined by the legal constraint $\overline{\eta}$, rather than by the incentive considerations highlighted by the economic theory of the firm.

These results are summarized in Lemma 2, which describes the organization of innovation with and without property rights as a function of the relative marginal efficiency of the parties' investments.

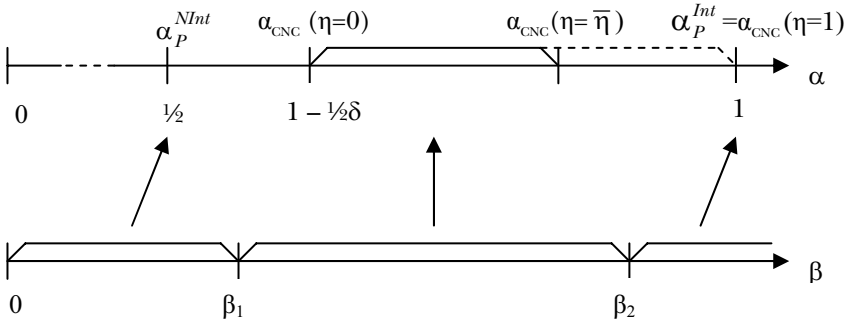
> *Lemma 2*: Two threshold values (β_1, β_2), satisfying $\beta_1 < \beta_2$, divide the parameter range $\beta \in [0, \infty)$, as follows:
>
> (i) When the relative marginal efficiency of *C*'s investment as compared to *RU*'s investment is sufficiently low—i.e., $\beta \leq \beta_1$—efficiency is maximized when the innovation is protected by property rights and these rights are allocated to *RU* (nonintegration). Absent property rights, inefficiency will be minimized by a $\eta = 0$ CNC—i.e., the parties will not sign a CNC.
>
> (ii) When the relative marginal efficiency of *C*'s investment as compared to *RU*'s investment is sufficiently large—i.e., $\beta \geq \beta_2$—efficiency is maximized when the innovation is

protected by property rights and these rights are allocated to *C* (integration). Absent property rights, inefficiency will be minimized by a $\eta = \overline{\eta}$ CNC—i.e., the parties will sign the strongest enforceable CNC.

(iii) When the relative marginal efficiency of *C*'s investment as compared to *RU*'s investment is between these extremes—i.e., $\beta \in (\beta_1, \beta_2)$—efficiency is maximized by an optimally designed CNC with $\eta \in (0, \overline{\eta}]$.

These results are depicted in Figure 2. Figure 2 illustrates the law's dual role in shaping the organization of innovation. First, the law determines whether property-based organization is possible. Second, the law determines the limits of CNC-based organization by imposing an upper bound on the strength of a CNC.

Figure 2



The following proposition states the role of the law in determining the organization of innovation and describes the welfare consequences of a legal policy denying property rights in the innovation, when the alternative to property-based organization is CNC-based organization.

Proposition 2: When, in the absence of property rights, the organization of innovation is CNC based,

(i) The legal policy denying property rights in the innovation will replace property-based organization with inefficient CNC-based organization when $\beta \leq \beta_1$ and when $\beta \geq \beta_2$. When $\beta \in (\beta_1, \beta_2)$, this legal policy will have no effect if parties can waive property rights and will increase efficiency otherwise.

(ii) A legal policy imposing stricter limits on enforceable CNCs—i.e., a lower $\overline{\eta}$—reduces β_2 and thus increases the inefficiency caused by the absence of property rights in the broader $\beta \geq \beta_2$ range and leads to a narrower $\beta \in (\beta_1, \beta_2)$ range where CNC-based organization is superior to property-based organization.

Part (iii) of Lemma 2 and Proposition 2 imply that CNC-based organization may be superior to property-based organization.[57] This does not imply any inefficiency in recognizing property rights in the innovation, as long as the parties can waive these rights in the ex ante contract—i.e., as long as parties can specify that neither party will obtain a property right and sign a CNC instead. In some cases such a waiver may be impractical or even legally unenforceable. In those cases, part (iii) of Lemma 2 and Proposition 2 provide a reason not to recognize property rights in the innovation.[58]

II. THE LAW

A. *Property or No Property*

We have argued that the organization of innovation depends on whether the innovation is legally protected. It is therefore important to understand the details of the legal framework that determines when innovation is afforded legal protection. We begin with patent law, which affords property right protection to a certain class of innovations. We then proceed to survey other sources of legal protection. Under these alternative sources, innovation can be protected at a level below property right protection. Even this lesser protection may be

[57] The parties cannot improve the outcome obtained under property-based organization by adding CNCs. CNCs are meaningless when the innovation is protected by property rights. First consider the integration case, where the property right is allocated to *C*. CNCs are meaningless in this case, since the allocation of property rights already provides *C* with maximal control. Next, consider the nonintegration case, where the property right is allocated to the employee. Without a CNC, *C*'s expected payoff is $\frac{1}{2} \times V(e, E) - E$ and the employee's expected payoff is $\frac{1}{2} \times V(e, E) - e$. The same payoffs are obtained with a CNC. When *C* makes the take-it-or-leave-it offer, the CNC is irrelevant. And when the employee makes the take-it-or-leave-it offer she will wield the superior power of the property right, again rendering the CNC meaningless.

[58] Alternatively, if we allow for stochastic property rights, then property rights again can only increase efficiency; stochastic property rights, however, may also be legally unenforceable. *See supra* note 49.

sufficient to allow standard organization of innovation, or what we have been referring to as property-based organization of innovation.

1. Patent Law

Patent law is the main legal field that governs innovation. Patent law creates and protects property rights in innovative products, methods of operation, and processes. A patent grants patentees protection for twenty years from the date on which the application is filed.[59] Over time, patent protection has expanded in scope to cover new subject matters and in some cases even embryonic inventions. Recently, however, we have witnessed some scaling back of the scope of patent protection and the ease with which it can be obtained.

Protection under the Patent Act is not available to ideas per se. The patent system is designed to reward inventors who transform the idea underlying an invention into "something of utility."[60] To receive a patent, an application must meet substantive and procedural requirements specified in the statutory scheme.[61] Specifically, it must describe an invention that is useful, novel, and nonobvious to a person skilled in the relevant art.[62] Our patent law affords protection only to manmade innovation, and not to natural or scientific facts. In this spirit, courts have been wary of extending the scope of patents to naturally occurring phenomena and basic scientific relationships.[63]

Until recently, patent protection enjoyed a period of strengthening and expansion, notwithstanding a significant scholarly opposition to this trend.[64] This trend manifested itself in various aspects of patent

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[59] 35 U.S.C. § 154(a)(2) (2006).

[60] *See* Arthur R. Miller, *Common Law Protection for Products of the Mind: An "Idea" Whose Time Has Come*, 119 HARV. L. REV. 705, 716-17 (2006) (describing how ideas cannot per se receive protection since "[p]atents protect inventions, and inventions are a discrete subset of ideas that have satisfied threshold . . . requirements").

[61] *See generally* 35 U.S.C. §§ 101–376.

[62] *See id.* §§ 101–103 (setting forth these general requirements).

[63] *See, e.g.*, Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 132 (1948) (holding that the patent sought was for a natural phenomenon and thus that the invention was not patentable); *see also* Michael Meehan, *The Handiwork of Nature: Patentable Subject Matter and* Laboratory Corporation v. Metabolite Labs, 16 ALB. L.J. SCI. & TECH. 311, 312 (2006) ("Although the wording of the statute is broad, it is nonetheless well established that mathematical algorithms, laws of nature, natural phenomena, and abstract ideas cannot be patented.").

[64] *See, e.g.*, Roberto Mazzoleni & Richard R. Nelson, *The Benefits and Costs of Strong Patent Protection: A Contribution to the Current Debate*, 27 RES. POL'Y 273, 281 (1998) (arguing that stronger patent protection may hinder rather than stimulate technological and economic process). Mazzoleni and Nelson also provide additional references

law, including the broadening of the definition of patentable subject matter to include, among others, business-method patents,[65] the encouraging of government-subsidized bodies (such as universities) to claim patent protection,[66] and the increasing tendency of the legal system to uphold patents.[67] As part of this trend, patent law has expanded to tolerate even merely embryonic innovation.[68] In *In re Strahilevitz*, for example, the Court of Customs and Patent Appeals—the precursor to the Federal Circuit—stated that an invention did not have to be built or tested to receive a patent, nor did there have to be a working model.[69]

Patent law provides an impressive array of remedies to successful plaintiffs, including injunctive relief, actual damages, treble damages for willful infringement, and attorneys' fees in exceptional cases.[70]

Recently, we have witnessed a certain retraction from the expansive trend that swept through the patent world. In a series of decisions, the Supreme Court and the Federal Circuit raised the patentability bar and narrowed the scope of protection. In 2007, in *MedImmune, Inc. v. Genentech, Inc.*, the Supreme Court held that a licensee can seek a declaratory judgment that a patent is invalid without first terminating or giving up the license.[71] This part of the ruling overturned the Federal Circuit's rule that the existence of a license

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supporting this academic trend opposing the expansion of patent protection. *See id.* at 282-84.

[65] *See, e.g.*, State St. Bank & Trust v. Signature Fin. Group, Inc., 149 F.3d 1368, 1372 (Fed. Cir. 1998) (emphasizing the broad statutory language of 35 U.S.C. § 101 to find a business method patentable), *abrogated on other grounds by In re* Bilski, 545 F.3d 943 (Fed. Cir. 2000).

[66] *See* Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 611, 614-15 (2008) (noting and discussing the rise of university patenting).

[67] This tendency is mainly due to the establishment of the United States Court of Appeals for the Federal Circuit in 1982. *See* Mazzoleni & Nelson, *supra* note 64, at 274 ("From 1982 through 1987, 89% of the district court decisions of patent validity have been upheld by the [Federal Circuit], up from 30% prior to [its] creation . . . .").

[68] *See* John F. Duffy, *Rethinking the Prospect Theory of Patents*, 71 U. CHI. L. REV. 439, 445 (2004) ("Policies that permit patenting of embryonic research results—that is, that allow patenting prior to the bulk of the investment needed to bring the innovation to market—increase the efficiency of the competition . . . .").

[69] 668 F.2d 1229, 1232 (C.C.P.A. 1982) ("We recognize that working examples are *desirable* in complex technologies . . . [but] examples are not *required* . . . .").

[70] *See* Robert P. Merges, *A Transactional View of Property Rights* 20 BERKELEY TECH. L.J. 1477, 1511-13 (2005) (comparing the potential remedies available under patent law with those available under contract law).

[71] 127 S. Ct. 764, 777 (2007).

agreement categorically eliminated "apprehension of suit" by the licensee.[72] Furthermore, in a footnote, the Supreme Court called into question the entirety of the Federal Circuit's declaratory-judgment jurisprudence.[73]

In another 2007 decision, *KSR International Co. v. Teleflex Inc.*, the Supreme Court unanimously rejected the Federal Circuit's rigid construction of the "teaching, suggestion, motivation" test employed to determine the obviousness of new inventions.[74] The Court emphasized the need for a flexible, common-sense approach to obviousness that takes account of motivations implicit in the prior art.[75] An important implication of the Court's ruling is that it will make it harder to secure—and easier to invalidate—patents.

The Federal Circuit, for its part, issued two important decisions concerning patentable subject matter. First, in 2007, the Federal Circuit decided in *In re Nuijten* that a signal cannot be patented since it is not a process, machine, manufacture, or composition of matter.[76] Second, in October 2008, the Federal Circuit's nine-to-three en banc decision in *In re Bilski* refused to accord protection to a process of hedging risks in commodity trading, stating that to be patentable a process must be connected to a machine or apparatus or must "transform[] a particular article into a different state or thing."[77] This decision limits the applicability of patent protection to certain business methods and processes and may portend a more restrictive construction of patentable subject matter more generally.

Finally, in *In re Ferguson*,[78] the Federal Circuit held that a method for marketing software and other products via shared marketing force cannot be patented as it does not constitute a patentable subject matter. The court reaffirmed its holding in *In re Bilski*, stating that "the Supreme Court's machine-or-transformation test is the 'definitive test to determine whether a process claim is tailored narrowly enough to encompass only a particular application of a fundamental principle

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[72] *See* Gen-Probe Inc. v. Vysis, Inc., 359 F.3d 1376, 1382 (Fed. Cir. 2004).

[73] *MedImmune*, 127 S. Ct. at 774 n.11 ("The [Federal Circuit's] reasonable-apprehension-of-suit test . . . conflicts with our decisions . . . .").

[74] *See* 127 S. Ct. 1727, 1739 (2007) (finding the Federal Circuit's test too narrow and inconsistent with precedent).

[75] *Id.*

[76] 500 F.3d 1346, 1357 (Fed. Cir. 2007), *cert. denied*, 172 L. Ed. 2d 1 (2008).

[77] 545 F.3d 943, 954 (Fed. Cir. 2008), *cert. granted sub nom.* Bilski v. Doll, No. 08-0964, 2009 WL 221232 (June 1, 2009).

[78] 558 F.3d 1359 (Fed. Cir. 2009).

rather than to pre-empt the principle itself.'"[79] The court, then, explained that since the applicant's method is neither tied to any machine or apparatus, nor transforms an article into a different shape or thing, it fails to "meet either prong of the machine-or-transformation test."[80]

2. Trade Secret Law

Trade secret law originated from the fields of torts, contracts, and equitable claims, rather than property.[81] To date, it remains controversial whether trade secrets enjoy property status. Traditionally, courts did not treat trade secrets as property rights. Yet in the last few decades, the courts have reversed course.[82] The change was motivated in part by the property-like characteristics of trade secrets (such as assignability) and in part by the courts' desire to strengthen incentives to innovate.[83] Nevertheless, several commentators disagree with the new approach and argue that trade secrets constitute at best quasi property or incomplete property rights.[84]

Indeed, trade secrets lack some of the defining characteristics of property rights. Trade secrets do not bestow upon their holder an in rem right (that is, a right that avails against the rest of the world); rather, trade secrets arise in the bilateral context of confidentiality du-

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[79] *Id.* at 1363 (quoting *In re* Bilski, 545 F.3d 943, 954 (Fed. Cir. 2008) (en banc)).

[80] *Id.*

[81] *See* Dan L. Burk, *Intellectual Property and the Firm*, 71 U. CHI. L. REV. 3, 9 (2004) (describing the "complex pedigree" of trade secrecy).

[82] *Compare* E.I. DuPont de Nemours Powder Co. v. Masland, 244 U.S. 100, 102 (1917) ("[T]he starting point for the present matter is not property . . . [but the defendant's] confidential relations with the plaintiffs . . . ."), *and* RESTATEMENT OF TORTS § 757 cmt. a (1939) ("[T]he protection is afforded only by a general duty of good faith . . . ."), *with* Ruckelshaus v. Monsanto Co., 467 U.S. 986, 1002 (1984) ("Trade secrets have many of the characteristics of more tangible forms of property."), *and* Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 481-85 (1974) ("[T]he encouragement of invention [is] the broadly stated polic[y] behind trade secret law.").

[83] *See* ROBERT P. MERGES ET AL., INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE 38 (4th ed. 2006) ("Treatment of trade secrets as property rights . . . is consistent with a view of trade secrets law as providing an additional incentive to innovate . . . ."); *see also* Pamela Samuelson, *Information as Property: Do* Ruckelshaus *and* Carpenter *Signal a Changing Direction in Intellectual Property Law?*, 38 CATH. U. L. REV. 365, 366 (1989) (discussing how "two recent . . . decisions classified information as private property").

[84] *See, e.g.*, Burk & McDonnell, *supra* note 23, at 603 ("[T]rade secrets . . . lacking the right to exclude, cannot properly be considered property rights at all."); Burk, *supra* note 81, at 11 ("[T]rade secrecy does not confer a property right, or at best it confers an incomplete property right.").

ties. Furthermore, trade secrets do not confer exclusivity upon their holder; a trade secret may be held by multiple holders at the same time.

Despite their weak proprietary status, the protection afforded to trade secrets is broad and strong, and if misappropriation of a trade secret can be proven, a variety of remedies becomes available to the holder, including injunctive relief and damages. The Uniform Trade Secrets Act, which has been adopted generally by the majority of jurisdictions,[85] defines trade secrets broadly to encompass any

> information, including a formula, pattern, compilation, program, device, method, technique, or process, that:
>
> (i) derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by, 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.[86]

The Restatement (Third) of Unfair Competition defines a trade secret broadly as well. Under the Restatement, the term includes "any information that can be used in the operation of a business or other enterprise and that is sufficiently valuable and secret to afford an actual or potential economic advantage over others."[87]

The broad definition of trade secrets implies that various types of commercially valuable information and business concepts that cannot be patented can easily be protected as trade secrets. It is clear, for example, that inchoate inventions, consumer lists, minimally innovative processes and methods, and "negative information"—that is, information about failed experiments, products, and methods—all come within the definition of trade secrets so long as they accrue economic value to the owner. Yet not all valuable information can be claimed under trade secret law. In order to be protected, information must be confidential and its holder must adopt reasonable measures to ensure its secrecy. Information that is either generally known or ascertainable to the market cannot be claimed as a trade secret.

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[85] It has been adopted by forty states, while the rest continue to apply the common law or separate state statutes. *See* RESTATEMENT (THIRD) OF UNFAIR COMPETITION § 39 statutory note at 437-38 (1995).

[86] UNIF. TRADE SECRETS ACT § 1(4) (amended 1985), 14 U.L.A. 537-38 (2005).

[87] RESTATEMENT (THIRD) OF UNFAIR COMPETITION § 39 (1995). The Restatement also expands the remedies provided in the course of trade secrets protection. *See id.* §§ 44–45 (providing for injunctive and monetary relief).

In addition, a trade secret does not confer exclusivity in the subject matter of the secret, as the law does not protect against reverse engineering or independent discovery of the trade secret.[88] The inventor remains vulnerable to such measures and may absorb a resulting decrease in the attractiveness of the information to prospective assignees.

On first impression, it also seems that trade secrecy constitutes a very strong form of protection. But this impression is incorrect; the protection is less effective than it first appears.[89] The main practical shortcoming of trade secret law is that it is difficult to prevail in an action for misappropriation of trade secrets.[90]

First, as noted above, trade secret protection is limited to the context of confidentiality duties, such as employment relationships or business partnerships. As a result, trade secret disputes typically arise in cases where a former employee or business partner is purported to have used confidential information or in the aftermath of failed negotiations.[91] In fact, concern for former employers' interests was among the main reasons for recognizing trade secret protection.[92]

Second, it is usually difficult to substantiate a misappropriation claim in court. Proving misappropriation of trade secrets requires a showing that the information could not be obtained from any other source.[93] In clear cases, of course, trade secret protection does have bite. Such cases may involve theft or industrial espionage by a competitor or appropriation of physical documents by former employees.[94] Yet most cases involve considerable cost and uncertainty, a fact that

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[88] Burk & McDonnell, *supra* note 23, at 600 (citing UNIF. TRADE SECRETS ACT § 1 cmt., 14 U.L.A 538).

[89] *See* 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, 600 (1999) ("[I]t remains the case that [trade secret] protection is limited . . . .").

[90] *See* Anton & Yao, *Start-Ups*, *supra* note 6, at 363 ("In practice, detection is problematic and court challenges . . . are difficult to win."); Gilson, *supra* note 89, at 598-600 (discussing barriers to legal victories in trade secret litigation).

[91] *See, e.g.*, Celeritas Techs. Ltd. v. Rockwell Int'l Corp., 150 F.3d 1354 (Fed. Cir. 1998) (arising from a manufacturer's alleged breach of an NDA between it and an inventor); Medtronic, Inc. v. Mine Safety Appliances Co., 468 F. Supp. 1132 (D. Minn. 1979) (arising from a failed business relationship).

[92] *See generally* MERGES ET AL., *supra* note 83, at 80-82 (discussing issues relating to departing employees and their former employers).

[93] Merges, *supra* note 70, at 28-29 (illustrating the difficulty of proving misappropriation under On-Line Techs., Inc. v. Bodenseewerk Perkin-Elmer GMBH, 386 F.3d 1133 (Fed. Cir. 2004)).

[94] *See, e.g.*, Alan Hyde, *Silicon Valley High Velocity Labor Market*, 11 J. APPLIED CORP. FIN., Summer 1998, at 27, 31-32 (describing an investigation of suspected corporate theft by a former employee of Intel).

weighs against bringing a lawsuit in the first place. Furthermore, in certain industrial environments, such as Silicon Valley, where the culture supports free movement of employees, firms that sue for misappropriation of trade secrets may incur reputational penalties.[95]

The secrecy requirement of trade secret protection thus detracts from the practical value of this form of legal protection by making it difficult to sell and license trade secrets to third parties. This problem is especially acute when the protected information needs to be disclosed in the precontractual stage of business negotiations. There are, of course, legal mechanisms designed to address this problem. Chief among those are NDAs that oblige the disclosee to refrain from disclosing confidential information. Powerful parties, however, 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. Even when an NDA is signed, its enforcement involves major evidentiary problems, owing in part to the complexity of defining the information and separating it from preexisting knowledge.[96]

In addition to the disincentive to enter negotiations faced by the disclosing party, the disclosee is disincentivized by the fewer rights that she receives. As discussed above, the disclosee cannot be guaranteed exclusivity (because of, for example, independent development or reverse engineering by a third party).[97] More generally, they cannot be provided with true residual control, and any contractual attempt to include it will be both incomplete and expensive, sometimes prohibitively so.[98] Patent protection makes it much easier to transfer the protected information relative to trade secret protection.

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[95] *See* Gilson, *supra* note 89, at 601 (discussing how firms "risk[] the imposition of labor market-imposed reputation penalties"); Hyde, *supra* note 94, at 32 (noting that "Intel acquired a reputation for being a bully towards its own employees, and may have paid for it" as potential employees "constantly asked . . . if they too would be sued if . . . they would someday leave the company").

[96] Arora & Merges, *supra* note 20, at 461.

[97] *See supra* text accompanying note 88.

[98] See Merges, *supra* note 70, at 7-9 (discussing costs associated with contractual protections).

3. Copyright Law

Although copyright protection does not extend to "any idea, procedure, process, system, method of operation, concept, principle, or discovery,"[99] it has a role in encouraging and protecting innovation.

A substantial advantage of the copyright regime is that protection attaches at the moment that the work is "fixed in any tangible medium."[100] This attachment mechanism is unlike that of patent and trade secret law, which are dependent upon time- (and money-) consuming processes, such as filing applications or negotiating contracts.

The copyright regime entitles a copyright owner only to the rights that are explicitly mentioned in the Copyright Act, and only for a limited time,[101] as opposed to the full residual right associated with a property right. With regard to these rights, the copyright regime carries property-like characteristics such as exclusivity[102] and injunctive remedies.[103] These characteristics, however, exist alongside considerable nonproperty features that limit their reach, such as compulsory-licensing schemes[104] and exemptions like the fair use doctrine (which essentially constitutes a compulsory license at zero royalties).[105] Consequently, copyright protection is less strong than the protection provided by the patent regime, which is largely free of broad exemptions and exceptions.

Moreover, the routes for permissible appropriation of a trade secret are available in copyright law as well. Like trade secret law, copyright law does not protect the creator from independent creation of

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[99] 17 U.S.C. § 102(b) (2006); *see also* Harper & Row, Publishers, Inc. v. Nation Enters., 471 U.S. 539, 547 (1985) ("[N]o author may copyright facts or ideas.").

[100] 17 U.S.C. § 102(a).

[101] *See id.* §§ 106, 302 (enumerating rights of copyright holders and their duration). In fact, however, commentators point towards an expansion of the copyright regime, stretching to an all-purpose, general-use right with no effective time limitation. *See, e.g.*, Jessica Litman, *Creative Reading*, LAW & CONTEMP. PROBS., Spring 2007, at 175, 183 ("[W]e need to remember that copyright was never intended to be a general-use right. Rather, Congress designed the statutory copyright as a collection of enumerated, individually bounded, exclusive rights.").

[102] *See* 17 U.S.C. § 106 (enumerating the "exclusive rights" of the copyright owner).

[103] *See id.* § 502(a) (authorizing injunctive remedies).

[104] Compulsory licenses are area specific. *See, e.g.*, *id.* § 114(d)(2) (providing compulsory licenses for digital transmissions of sound recordings); *id.* § 115 (providing compulsory licenses for "cover" music).

[105] *See* Dan L. Burk, *Patenting Speech*, 79 TEX. L. REV. 99, 158-60 (2000) (discussing how fair use may be considered a compulsory-licensing scheme).

an identical work.[106] Similarly, in the area of computer software, a copyrighted work is vulnerable to reverse engineering.[107] Indeed, courts have established the lawfulness of intermediate copying and decompilation of computer software when it is intended to extract public domain elements and develop interoperable or competing products.[108]

In addition, copyright law occupies an intermediate position between the disclosure regimes of patents and trade secrecy. On the one hand, copyright protection is not conditioned upon publication, as patent protection is rare, but on the other hand, it does require fixation in a tangible medium of expression. Moreover, publication may prove to be rewarding in the evidentiary structure of copyrights because it creates a presumption that a later similar work was copied rather than independently created.[109]

Copyright law incorporates the "work made for hire" doctrine, which vests in employers copyrights in original works made by their employees.[110] While this doctrine increases certainty to some degree, its boundaries are blurry because of the practical difficulty that some-

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[106] *See, e.g.*, Sheldon v. Metro-Goldwyn Pictures Corp., 81 F.2d 49, 54 (2d Cir. 1936) ("[B]ut if by some magic a man who had never known it were to compose anew Keats's Ode on a Grecian Urn, he would be an 'author' . . . .").

[107] Reverse engineering constitutes infringement in other areas of copyright law when it involves so-called "intermediate copying." *See, e.g.*, Sega Enters. Ltd. v. Accolade, Inc., 977 F.2d 1510, 1518-28 (9th Cir. 1993) (holding that intermediate copying of computer code is infringement, but finding it protected fair use in this case); Walker v. Univ. Books, Inc., 602 F.2d 859, 864 (9th Cir. 1979) (finding intermediate copying of blueprints to be infringement); Walt Disney Prods. v. Filmation Assocs., 628 F. Supp. 871, 876 (C.D. Cal. 1986) (holding that intermediate copying of story boards and scripts was infringement).

[108] *See, e.g.*, Sony Computer Entm't, Inc. v. Connectix Corp., 203 F.3d 596, 602-03 (9th Cir. 2000) (concluding that where copying is necessary to access functional elements, it constitutes fair use); Atari Games Corp. v. Nintendo of Am. Inc., 975 F.2d 832, 844 (Fed. Cir. 1992) (holding Atari's noncommercial reverse engineering to be fair use); *see also* Dennis S. Karjala, *Copyright Protection of Computer Documents, Reverse Engineering and Professor Miller*, 19 U. DAYTON L. REV. 975, 993 (1994) (suggesting that the object-code exception to copyright exists to limit copyright's strength and breadth); J.H. Reichman, *Design Protection and the New Technologies: The United States Experience in a Transnational Perspective*, 19 U. BALT. L. REV. 6, 143-44 (1989) ("[B]y encouraging third parties to make free and abundant use of nonprotectable matter underlying the protected expression, copyright laws foster a built-in process of 'reverse engineering' that enables many copyrightable works to cluster around common themes or ideas.").

[109] *See, e.g.*, ABKCO Music, Inc. v. Harrisongs Music, Ltd., 722 F.2d 988, 998 (2d Cir. 1983) (noting that the widespread dissemination of the allegedly copied work could support a finding of access to it); Douglas Lichtman, *Copyright as a Rule of Evidence*, 52 DUKE L.J. 683 (2003).

[110] *See* 17 U.S.C § 101 (2006) (defining, among other things, "work made for hire").

times arises in discerning the distinction between employees and contractors.[111]

Copyright law affords rights holders a wide array of remedies, including injunctions, actual and statutory damages, disgorgement of an infringer's profits, and impoundment and destruction of infringing articles.[112]

In sum, then, it can be said that copyright law encourages disclosure of commercially valuable information, but not nearly as much as patent law does. Relative to trade secrecy, copyright protection allows greater employee mobility and permits interfirm transactions, and it avoids the problems associated with these goals in the trade secret regime resulting from the undisclosed nature of the information in that area.[113]

4. The Law of Ideas

It is important to note at the outset that there is no federal body of law specifically designed to provide direct legal protection to ideas. Thus, state law will be the focal point of this discussion.[114] As far as state law is concerned, protection for ideas was historically left to the courts and was developed by a process of accretion. A review of the case law reveals that courts have applied various common law doctrines on an ad hoc basis to afford protection to ideas in certain situations. These efforts resulted in a largely inconsistent and incoherent body of law.[115]

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[111] *See* Barak Y. Orbach, The Law and Economics of Hired Creativity: Who Should Own the Rights? 46-47 (Oct. 27, 2003) (unpublished manuscript), *available at* http://www.law.umich.edu/centersandprograms/olin/workshops/Documents/Fall2003/orbach.pdf ("[M]uch of the discussion . . . under copyright law . . . is focused on the evasive . . . distinction between employees and independent contractors.").

[112] *See* 17 U.S.C. §§ 502–505, 509.

[113] *See* Burk, *supra* note 81, at 9 ("Resolving trade secrecy disputes is especially problematic in the case of employee departure, as courts are reluctant to curtail the mobility of labor."); *see also* Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CAL. L. REV. 1293, 1302-07 (1996) (discussing intellectual property regimes from both liability-rule and property-rule perspectives).

[114] *See generally* Desny v. Wilder, 299 P.2d 257, 270 (Cal. 1956) (en banc) (using implied contracts to protect ideas from disclosure and misappropriation); Bristol v. Equitable Life Assurance Soc'y, 30 N.E. 506, 507 (N.Y. 1892) (applying New York law of ideas); Peabody v. Norfolk, 98 Mass. 452, 459-60 (1868) ("In this court, it is settled that a secret art is a legal subject of property . . . .").

[115] *See, e.g.*, Miller, *supra* note 60, at 731 (noting that these common law doctrines resemble federal patent and copyright requirements but concluding that "their application in idea law is misguided").

The starting point for these judicial efforts has usually been that ideas do not deserve property protection.[116] Therefore, plaintiffs were forced to rely on other doctrines, such as contracts, quasi-contracts, confidential relationships, and unjust enrichment to prove their claims.[117] Typically, they did not prevail.[118] The courts' reluctance to protect pure ideas was driven both by a desire to prevent the monopolization of ideas and by a concern about the evidentiary and administrative difficulties associated with such protection.[119]

Although state laws concerning protection of ideas are ambiguous and therefore difficult to classify and analyze, it is possible to discern two threshold parameters that ideas must satisfy to win protection.[120] The first is concreteness: to be protected, an idea must be concrete and not merely abstract.[121] The second is its novelty, sometimes addressed as "originality,"[122] meaning that the idea is beyond the general knowledge in the field.[123]

The requirement of concreteness is vague, and it varies among jurisdictions. Some courts have required ideas to be both reduced to a

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[116] *See id.* (noting judicial reluctance to allow compensation for misappropriation of ideas); *see also* Larissa Katz, *A Powers-Based Approach to the Protection of Ideas*, 23 CARDOZO ARTS & ENT. L.J. 687, 706 (2006) ("We cannot look to property theory to uncover the source of the duty not to use or disclose another's idea shared in confidence for the simple reason that idea-submission law concerns a more limited or *in personam* rights-duty relationship than the *in rem* rights-duty relationship that property law describes.").

[117] *See* Katz, *supra* note 116, at 706-15 (detailing the various approaches); Miller, *supra* note 60, at 764-73 (same).

[118] *See* Miller, *supra* note 60, at 731.

[119] *See id.* at 720 (discussing these "two core concerns underlying the courts' reluctance to recognize a protectable interest in ideas").

[120] *But see* Katz, *supra* note 116, at 692 (noting four prerequisites: novelty, originality, confidentiality, and concreteness). This different classification is largely semantic, but it does demonstrate the courts' inconsistency.

[121] *See, e.g.*, Stone v. Liggett & Myers Tobacco Co., 23 N.Y.S.2d 210, 212 (App. Div. 1940) ("[O]wing to the difficulties of enforcing such rights, the courts have uniformly refused to assume to protect property in ideas that have not been reduced to a concrete form."); Williamson v. N.Y. Cent. R.R. Co., 16 N.Y.S.2d 217, 217-18 (App. Div. 1939) (per curiam) ("Plaintiff's idea never took on concrete form at the time of disclosure so as to give rise to a property right . . . ."); Alberts v. Remington Rand, Inc., 23 N.Y.S.2d 892, 894 (Sup. Ct. 1940) ("Only where the idea has been reduced to concrete form prior to its disclosure to and appropriation by the defendant may recovery be had upon an implied contract.").

[122] Miller, *supra* note 60, at 726.

[123] For a view that criticizes these standards and offers an alternative framework, see *id.* at 731-32.

tangible form and highly detailed and developed,[124] while others have only adhered to the first requirement of tangibility.[125] Courts' interpretations of the novelty requirement also vary across jurisdictions.[126] Most jurisdictions strictly require that an idea be absolutely and objectively novel—meaning unknown in the field in general—in order to receive protection. New York, in contrast, is more flexible. The courts in New York require that the idea be novel only to the recipient when a confidentiality or nondisclosure contract is signed between the parties prior to disclosure.[127] Moreover, postdisclosure agreements are enforceable in New York regardless of the novelty of the idea.[128] In the absence of a formal contract between the parties, however, when the misappropriation claim is predicated on theories of quasi-contract or breach of a confidential relationship, the New York courts reintroduced the strict novelty standard, requiring the plaintiff to prove that her idea is novel in absolute and objective terms.[129] The novelty stan-

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[124] *See, e.g.*, Smith v. Recrion Corp., 541 P.2d 663, 665 (Nev. 1975) ("An idea in order to meet the test of concreteness must be ready for immediate use without any additional embellishment.").

[125] *See, e.g.*, Flemming v. Ronson Corp., 258 A.2d 153, 156 (N.J. Super. Ct. Law Div. 1969) ("The concept submitted by [plaintiff] is not an abstract one in the sense that it is incapable of physical form. Rudimentary as it is, the idea can be transformed into a product. It is, to that extent, concrete and usable."), *aff'd*, 275 A.2d 759 (N.J. Super. Ct. App. Div. 1971). Professor Miller criticizes requiring tangibility as anachronistic, especially in light of the development of intangible injuries, assets, and concepts in other fields of the law. *See* Miller, *supra* note 60, at 724.

[126] *See* Katz, *supra* note 116, at 693 (noting that across jurisdictions, there is a lack of clarity on how to assess and distinguish novelty criteria); Mary LaFrance, *Something Borrowed, Something New: The Changing Role of Novelty in Idea Protection Law*, 34 SETON HALL L. REV. 485, 485-86 (2004) (noting that "[i]dea protection doctrine . . . differs primarily in the role played by the concept of 'novelty'" and noting that "[t]here is no one authoritative definition of novelty in this context").

[127] *See* LaFrance, *supra* note 126, at 486 (discussing New York's novelty requirements).

[128] *See* Apfel v. Prudential-Bache Sec. Inc., 616 N.E.2d 1095, 1098 (N.Y. 1993) ("The law of contracts would have to be substantially rewritten were we to allow buyers of fully disclosed ideas to disregard their obligation to pay simply because an idea could have been obtained from some other source or in some other way."); *see also* LaFrance, *supra* note 126, at 486 ("New York requires some form of novelty as a prerequisite to all forms of idea protection other than post-disclosure contracts.").

[129] *See* Nadel v. Play-By-Play Toys & Novelties, Inc., 208 F.3d 368, 380 (2d Cir. 2000) ("[M]isappropriation claims require that the idea at issue be original and novel in absolute terms. This is so because unoriginal, known ideas have no value as property and the law does not protect against the use of that which is free and available to all."); *see also* LaFrance, *supra* note 126, at 492-95 (summarizing the *Nadel* decision and its implications).

dard with respect to suits based on a theory of unjust enrichment remains unclear in New York and is subject to scholarly debate.[130]

California law takes a more liberal approach to the novelty requirement in cases of predisclosure agreements,[131] an approach that has been followed by other states.[132] In California, the question of novelty has taken on an evidentiary nature; it is treated as evidence of contractual consideration rather than as a necessary element.

The New Jersey courts are quite vague on the subject, and the case law does not provide clear guidance on the novelty requirement.[133]

Professor Miller has argued that the application of the concreteness and novelty parameters bars protection to the vast majority of ideas.[134] Thus, according to Miller, as far as the legal protection of ideas is concerned, current state protection does not represent a major improvement over the nonexistent federal protection.[135]

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[130] *Compare* LaFrance, *supra* note 126, at 486 ("For an idea to be protected under unjust enrichment/quasi-contract, however, the idea must be novel in the general or absolute sense—in other words, unknown not only to the buyer but also to the public in general."), *with* Katz, *supra* note 116, at 695-96 ("For unjust enrichment claims in New York and California, a plaintiff need only establish that the idea was novel to the defendant, rather than generally or objectively novel.").

[131] *See* Donahue v. Ziv Television Programs, Inc., 54 Cal. Rptr. 130, 134 (Cal. Dist. Ct. App. 1966) ("An idea which can be the subject matter of a contract need not be novel . . . ."); LaFrance, *supra* note 126, at 486 (noting that novelty is not required for ideas disclosed pursuant to an express or implied-in-fact contract in California); Ronald Caswell, Comment, *A Comparison and Critique of Idea Protection in California, New York, and Great Britain*, 14 LOY. L.A. INT'L & COMP. L.J. 717, 723 (1992) ("Under California's [quasi-contract] analysis, it is irrelevant whether an idea contains the element of novelty.").

[132] Wrench LLC v. Taco Bell Corp., 256 F.3d 446, 461-63 (6th Cir. 2001) (predicting that Michigan courts would follow the California approach); Reeves v. Alyeska Pipeline Serv. Co., 926 P.2d 1130, 1141 (Alaska 1996) (adopting the California approach).

[133] The leading novelty case in New Jersey, *Flemming v. Ronson Corp.*, 258 A.2d 153, 156-57 (N.J. Super. Ct. Law Div. 1969), *aff'd*, 275 A.2d 759 (N.J. Super. Ct. App. Div. 1971), favors no novelty prerequisite in the contractual framework. The recent case of *Johnson v. Benjamin Moore & Co.*, 788 A.2d 906, 914-18 (N.J. Super. Ct. App. Div. 2002), *cert. granted and summarily remanded*, 796 A.2d 893 (N.J. 2002), deviated from *Flemming* and demonstrated a willingness to adopt such a novelty standard. *Johnson*, however, has since been remanded (in light of the plaintiff's receipt of a patent) and thus no longer represents controlling law. Hence, the New Jersey courts have an opportunity to reconsider the issue. *See* LaFrance, *supra* note 126, at 486-87 (suggesting that New Jersey courts take this opportunity to "carve out a more thoughtful approach" to idea law).

[134] Miller, *supra* note 60, at 730-32.

[135] *See id.* (summarizing the overarching problems with the current state of idea-law doctrine). Professor Miller believes that because of the modern significance of ideas for a wide range of businesses and industries, the law should grant greater protection to ideas, especially in light of the need to stay competitive in a global market

5. Summary

Thus far, we have reviewed the various federal and state bodies of law that pertain to innovation. In theory, patent protection offers the strongest protection by affording exclusivity against the rest of the world, including inventors who independently come up with the protected invention, for a period of twenty years from the date of filing.[136] The expense and difficulty associated with securing and enforcing patent protection, however, undermine the effectiveness of patent protection for many inventions. Moreover, recent developments have narrowed the range of innovations that are eligible for patent protection.

Trade secrecy is another important source of legal protection for innovation.[137] The subject matter of trade secret law is much broader than the subject matter of patent law, but the protection provided by trade secret law is weaker than patent protection. Although in principle trade secret law covers all types of information, one cannot rely on trade secrecy with respect to information that may be readily discerned from the design of products and processes and information that may be extracted via reverse engineering. Furthermore, while trade secret law purports to protect the employer's tacit information, in reality employers who seek to assert their rights against former employees are rarely successful, except in evident cases involving actual appropriation of documents by the employee.

Copyright law also affords some protection to innovation, albeit indirectly.[138] Copyright protection is limited to the expression of innovation, rather than the innovation itself, and it is subject to some broad exceptions and exemptions that may adversely affect the innovator. The work-made-for-hire doctrine in copyright law protects employers to some extent against disclosure by ex-employees concerning the employee innovation. But since copyright protection does not extend to ideas and concepts, and only to the expression thereof, the protection that it affords to former employers is very limited when the idea or concept may be expressed in multiple ways.

Naked ideas are offered a very minimal level of protection in our legal system.[139] Such ideas cannot be protected under patent or copy-

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that creates alternative markets for ideas for American and foreign idea vendors. *See id.* at 705-06.

[136] *See supra* subsection II.A.1.

[137] *See supra* subsection II.A.2.

[138] *See supra* subsection II.A.3.

[139] *See supra* subsection II.A.4.

right law. They enjoy a certain degree of protection under trade secret law, as well as under certain state law doctrines providing direct protection to ideas.

B. *Indirect Protection of Innovation: CNCs*

As explained above, the direct legal protection afforded to innovation is limited.[140] In the employment context, these limited direct modes of protection are supplemented by indirect modes of protection: employers rely on legal doctrines that protect information by restraining departing employees from using knowledge obtained at their firms. These doctrines include, among others, breach of a duty of loyalty, unfair competition, breach of nondisclosure agreements, and, most importantly, covenants not to compete.

Covenants not to compete forbid an employee from competing with an employer for a certain period of time after the termination of employment, typically one or two years, within a limited geographic area related to the employer's market. By restricting employee mobility, such covenants limit knowledge spillovers and indirectly protect employers' information.

In most states, covenants not to compete are enforceable if they are not unreasonable and excessive in duration or geographical scope.[141] The importance of covenants not to compete is growing, as more and more employees are required to sign them.[142] Lawsuits for breach of covenants not to compete have become common and are currently among the most frequently litigated issues in employment law.[143]

Historically, courts were reluctant to enforce covenants not to compete because of the disparities in bargaining power between employers and employees, as well as the effect that the covenants have on employees' ability to make a living. Likewise, courts were concerned

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[140] *See supra* Section II.A.

[141] *See* Hyde, *supra* note 94, at 30.

[142] *See* Katherine V.W. Stone, *Knowledge at Work: Disputes over the Ownership of Human Capital in the Changing Workplace*, 34 CONN. L. REV. 721, 738-39 (2002) ("Covenants not to compete and covenants not to disclose information have become commonplace in employment contracts over the past ten years. In addition to their increased presence in negotiated, fixed-term employment contracts, such covenants have also been inserted into at-will employment relationships.").

[143] *See id.* at 739 (tracking the increase of litigation involving covenants not to compete in decisions available on Westlaw).

about the adverse effects of CNCs on employee mobility, the labor market, and trade in general.[144]

Over time, however, courts warmed to CNCs and adopted a "rule of reason" approach to their enforcement. Under this standard, courts enforce CNCs of reasonable duration and geographic coverage, as they neither constrain employee mobility beyond what is necessary to protect the employer's legitimate business interests nor contradict the public interest. The definition of reasonableness varies among states and between cases.

Traditionally, courts applied a higher level of scrutiny to CNCs in at-will employment relationships. Courts employed various tests to ensure that employees who could be terminated at will had received valid consideration in return for signing the covenant not to compete.[145] This higher standard of review in cases involving termination at will has largely eroded in recent years. And while there are still courts that decline to enforce covenants not to compete in cases of unjustified dismissal, ignoring the at-will clause, other courts readily enforce them even in such cases.[146]

It is noteworthy that the courts have contributed to the widespread use of CNCs by developing a practice of rewriting invalid covenants and then enforcing the modified terms, rather than rejecting the entire covenant as courts did in the past.[147] Over time, courts have also expanded the list of employer interests that justified enforcement of covenants not to compete. In the past, CNCs were only enforced if a trade secret of the employer was at stake; today, many courts have abandoned that requirement.[148] For example, in most states, courts regularly enforce CNCs to protect a former employer's customer list, even if the list is not secret.[149] Similarly, courts have recently enforced covenants not to compete in cases where the employer paid for an employee's training on the ground that the employer is entitled to prevent the employee from using the skills that she acquired in the

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[144] *See id.* at 740.

[145] *See id.* at 742 (explaining that one test is whether the CNC is "ancillary to an otherwise valid transaction").

[146] *See id.* at 743-44 (discussing the various courts' responses to CNCs in cases of unjustified dismissal).

[147] *See id.* at 744 ("The current approach of a majority of courts is either to rewrite an invalid covenant and enforce it as rewritten or to delete the invalid portions and enforce the remainder.").

[148] *See id.* at 747 (noting this expansion and the elimination of the trade secret requirement).

[149] *See id.* at 749.

training while employed by a competitor, even though no trade secrets were disclosed to the trainee.[150]

An important exception to the modern trend of enforcing CNCs is California. California law provides that "every contract by which anyone is restrained from engaging in a lawful profession, trade, or business of any kind is to that extent void."[151] The courts have interpreted this law broadly to invalidate CNCs.[152]

Professor Gilson has argued that California's reluctance to enforce CNCs accounts for the rise of Silicon Valley relative to high-tech centers in other states, such as Route 128 in Massachusetts.[153] Professor Gilson explained that the unenforceability of CNCs led to knowledge spillovers and information sharing, which generated considerable agglomeration effects and increased the innovative capacity of the high technology sector.[154]

CONCLUSION

The organization of innovation can be based on property rights, on verifiable contractual provisions (CNCs), on access that is controlled or limited by law (trespass) or technology, and on reputation. In this Article, we have focused on the first three organizational forms. Specifically, we analyzed how the availability and scope of different kinds of legal protection to innovation delineates the boundary between firm and market in the high-tech industry.

Although we did not engage in an in-depth analysis of reputation-based organization of innovation, we recognize this possibility and its importance. As Professors Burk and McDonnell warned, one must be cautious not to overstate the role of property rights or forms of legal protection in business settings, since nonlegal mechanisms, such as business norms, expectations, and reputation, play a significant role in such environments.[155] We agree.

Reputation can be an effective substitute for organization, and it can cure problems of uncontractability. For example, many of the

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[150] *See id.* at 751 (discussing the courts' recent focus on "who pays" for the training as a justification for enforcing CNCs in such circumstances).

[151] CAL. BUS. & PROF. CODE § 16,600 (West 2008).

[152] *See* Hyde, *supra* note 94, at 29-30 (observing that CNCs have been unenforceable in California for over a century because of this statute).

[153] Gilson, *supra* note 89, at 578.

[154] *Id.* at 578-79.

[155] Burk & McDonnell, *supra* note 23, at 602.

contracting challenges that we discussed will not arise if buyers or financiers of innovation have a strong reputation for not stealing others' ideas. Likewise, a research unit famous for its innovative capabilities may be able to secure financing for its projects even without fully disclosing them to financiers—or at the very least, may get the latter to sign an NDA. Correspondingly, an employer who establishes for herself a reputation for generously rewarding employees for innovation will be spared many of the contracting problems that we addressed. Perhaps the best example of the significance of reputation is provided by venture-capital firms.[156] Venture-capital firms with established reputations can (and do) assuage Arrow's disclosure paradox. Thanks to their reputation, such firms can on many occasions gain access to unprotected information generated by innovators.

The requisite level of reputation that can form a substitute for legal protection is not easy to attain, however. Transactions over innovation are characterized by a high degree of suspicion and initial mistrust. Innovators are wary about disclosing their innovations for fear that the information will leak to others. Buyers and financiers of innovation, for their part, will be reluctant to transact without full disclosure since most innovations are commercially valueless. Given that reputation usually results from repeated behavior over time, it may be very difficult to build a good reputation in this environment.

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[156] We thank Phil Weiser for pointing out this example to us.