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THE LAW AND ECONOMICS OF EMPLOYEE INVENTIONS

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I. INTRODUCTION

Most employees do not hold property rights in the things they invent on the job. By default or, more commonly, contract, ownership usually rests with the firm that employs them. This has been widely criticized, mostly on the basis that it is unfair.[1] Why, the question goes, should the employer own the fruits of the employee's unique talent, skill, and insight? Some, moving beyond the fairness issue, say employer ownership dampens incentives to invent.

Few have spoken up for the prevailing legal regime, and fewer still have mounted a systematic defense of the status quo. This Article does both. It defends prevailing default rules, as well as the strong presumption that employee invention contracts should be enforced.[2] Four distinct bodies of economic theory inform the argument, each contributing support for the law as it stands:

- strategic bargaining analysis, which militates against giving an employee a property right that could be asserted after the employer firm has made investments to produce the employee's invention;[3]
- team production theory, which describes the difficulty of crafting individual compensation for each of a number of team members who contribute collectively to a team goal, such as a joint invention;[4]

1. *See, e.g.*, Ann Bartow, *Inventors of the World, Unite! A Call for Collective Action by Employee-Inventors*, 37 SANTA CLARA L. REV. 673 (1997); Steven Cherensky, Comment, *A Penny for Their Thoughts: Employee-Inventors, Preinvention Assignment Agreements, Property, and Personhood*, 81 CAL. L. REV. 597 (1993); Jay Dratler, Jr., Note, *Incentives for People: The Forgotten Purpose of the Patent System*, 16 HARV. J. ON LEGIS. 129 (1979); Ron Riley, *Inventors Deserve Their Fair Share*, MACHINE DESIGN, Mar. 21, 1994, at 109. *See generally* DAVID F. NOBLE, AMERICA BY DESIGN (1977).

2. Because this Article deals with inventions covered by property rights, it differs from the analysis in James J. Anton & Dennis A. Yao, *Start-Ups, Spin-Offs, and Internal Projects*, 11 J.L. ECON. & ORG. 362 (1995), which discusses cases where employees conceive of inventions that, at best, can be protected by trade secret law. Trade secret law, unlike patent law, does not allow the inventor to exclude others from using his invention; trade secret law only helps the inventor keep his invention secret. The Anton and Yao model employs the threat of nonexclusivity as a bargaining lever: an inventor can approach a potential licensee and offer an exclusive license on an invention, with the latent threat that if the licensee does not honor the contract, the inventor can disclose the idea to others and destroy the trade secret.

3. *See infra* Part IV.A.

4. *See infra* Part IV.B.

number of team members who contribute collectively to a team goal, such as a joint invention;[4]

- principal-agent theory, which demonstrates that when employees are assigned to multiple tasks (e.g., inventing, producing, *and* marketing), managers must take care lest employee compensation be tied too closely to one measurable task;[5] and
- common-sense analysis of the bargain struck between the firm and inventive employees, which recognizes the high risk of failed inventions, the stability of employee salaries over time, and the firm's need to recoup the costs of failed inventions via ownership of those that are successful.[6]

Thus, the overwhelming verdict from economic theory is that the law properly allows employers to take ownership of their employees' inventions. But this Article's criticism of the pro-employee literature does not stop there. This reform literature suffers from myopia, focusing on the ownership of inventions as the *only* form of employee compensation. This Article takes a step back and appreciates the full economic picture, one more favorable to employees.

Employers compensate employee-inventors in two ways. First is the widespread, and apparently growing, movement by firms to establish internal reward systems for their inventive employees. While avoiding the myriad problems of outright employee ownership, these reward programs go at least part of the way toward providing more high-powered incentives for employees to engage in inventive work. Second, the law has long contained a quietly effective escape hatch, allowing creative employees to exit a firm before an inventive concept has taken on a concrete, tangible form. The possibility of leaving a firm with an inchoate concept, perhaps with venture capital backing, constitutes an important counterbalance to the rights of the employer firm. An employee, armed with such a threat, has greater bargaining leverage with an employer or prospective employer. In this way, the implicit exit option can make employed inventors better off as well. When these two aspects of compensation are considered, employee-inventors appear much better off than the law of invention ownership alone might suggest.[7]

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4. *See infra* Part IV.B.
5. *See infra* Part IV.C.
6. *See infra* Part IV.D.
7. *See infra* Part V.

Before jumping into the rules governing employee inventions, it is useful to see the law of invention ownership in the broader perspective of recent property law scholarship. A number of scholars, in particular Michael Heller, have argued that courts and legal commentators should be aware of the downstream effects of granting property rights.[8] In particular, Heller argues that granting many property rights to multiple owners can create what he calls an "anticommons," producing more problems than it solves. While admitting that individual property rights confer the benefits conventionally associated with individual ownership — especially better incentives to maximize the value of the underlying assets — these scholars make the case that the transaction costs of re-assembling rights can swallow all the gains. This argument recommends against granting rights in some cases and informs issues such as where to set boundaries in others.[9]

The law of employed inventors implicitly addresses one key concern of anticommons theory. The prevailing legal regime solves the post-grant transactional bottleneck by permitting enforceable *pre-assignment* contracts. These agreements square away ownership issues — thus preventing costly bargaining breakdown — before property rights are granted, and indeed before the assets covered by the rights are even in existence. Taken as a whole, then, this body of law offers a fascinating hybrid: fine-grained property rights, of precisely the type Heller and others see as problematic, but mediated by clear contractual rules.[10] Perhaps this pairing of property rights and contract rules could solve the anticommons problem in other cases as well.

II. SUMMARY OF THE LAW

Two sets of rules govern employer-inventors: (1) default rules, under a branch of state common law, and (2) employee-employer contracts.

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8. *See* Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621 (1998); Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, SCIENCE, May 1, 1998, at 698.

9. *See* Michael A. Heller, *The Boundaries of Private Property*, 108 YALE L.J. 1163 (1999).

10. Even in the absence of ex ante contracts, under some circumstances, rightsholders can overcome the transaction costs of multiple, independent ownership by joining together to create institutions that facilitate the exchange of intellectual property rights. *See* Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CAL. L. REV. 1293 (1996) [hereinafter Merges, *Contracting into Liability Rules*].

A. Default Rules

Although many employees sign contracts governing ownership of inventions, default rules continue to be important because in an appreciable number of cases there is no explicit contract.[11] Inadvertence, the trend toward more inter-firm cooperation in research and development ("R&D"), and increasingly fluid concepts of employment all create cases where default rules govern. In these cases, one of three default rules will apply to an employee who invents something.

1. Firm-Owned Inventions

Even in the absence of a contract, the employer owns the inventive output of an employee who is "hired to invent" — i.e., whose primary job responsibility is to solve a specific technical problem. The same is true today for general R&D employees, though in older cases this was in doubt.[12] The implied contract covering employment of this nature is said to include the notion that the employer will retain title to any patentable inventions produced by R&D employees because, in a sense, the employees have already been compensated through their wages.

Close cases sometimes arise under two fact patterns. First, an R&D employee may bring with him an already-complete invention. Such inventions are generally excluded from the implied contract; the

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11. *See, e.g.*, Teets v. Chromalloy Gas Turbine Corp., 83 F.3d 403 (Fed. Cir. 1996) (finding implied-in-fact contract when no written agreement existed between project leader and employer).

12. The older cases usually gave ownership of inventions to general R&D employees. The shift to the modern rule took two forms: the emergence of a default rule in favor of employer ownership for all inventions by R&D employees, and the expansion of employment contract principles to include express and implied assignment of invention rights. For an excellent summary of this transition, see Catherine L. Fisk, *Removing the 'Fuel of Interest' from the 'Fire of Genius': Law and the Employee-Inventor, 1830–1930*, 65 U. CHI. L. REV. 1127 (1998). Fisk's general summary is masterful. She describes in detail the shift between 1830 and 1930 from a relatively pro-employee legal standard to today's pro-employer rules. She argues that one cause of the change in legal doctrine was the changing nature of technology and the growth of corporate (i.e., team) research. *See id.* at 1141. Another was the shift in ideology that followed from these changes. *See id.* at 1162. Surely there is some truth in both assertions. Looking at the techno-economic setting of employee inventions, it seems evident that the pro-employee decisions in the earlier years came predominantly in single-inventor cases involving relatively straightforward inventions such as agricultural implements. The later, more pro-employer decisions, involved relatively more sophisticated technologies: manufacturing machinery, industrial processes (e.g., rubber production), radio condensers, and the like. To the extent these more complicated technologies involved greater integration of the work of multiple inventors, and of particular inventions with the pre-existing knowledge and production assets of the employer firm, a rule favoring employer ownership makes sense. *See infra* Part IV.B.

employee retains title, and the employer either has a shop right[13] or must obtain a license like anyone else (unless one was implied from the dealings of the parties). Second, an R&D employee may invent something unrelated to his job description. The default rule in this case is far from certain, though some speak of a clear rule in favor of the employee. General R&D employees are therefore one of the most important groups for the firm to bring under contract. Note, however, that some state statutes supply immutable rules, overcoming an employer's ability to contract around the default rule.[14]

2. Firm-Related Inventions

Non-R&D employees often make inventions. When they do, ownership is determined by two factors: whether the invention relates to the employee's job duties, and whether it was made using the facilities, tools, personnel, or other resources of the employer.[15] The cases applying these factors are testing for the degree of complementarity between the invention and the employer's other assets.

When a non-R&D employee invents something closely related to the employee's duties (i.e., the firm's operations) or using firm resources, the employee retains title. However, this is subject to an implied-in-law royalty-free license in favor of the employer. This license is called a "shop right.". The resulting ownership structure is a split entitlement: the firm retains the use of the invention in its business, while the inventor-employee holds title and therefore the residual rights to employ the invention at his discretion.[16] While usually described in terms of fairness, the shop right also affects the incentives of non-R&D employees in a number of important ways.[17]

3. Independent Inventions

Inventions unrelated to job function or made away from the job site using employee resources often belong exclusively to the employee. This is true in *most* cases of non-R&D employees and in *some* cases of R&D employees, though employer contracts frequently assert ownership

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13. *See infra* text accompanying note 16.
14. *See infra* notes 30–32 and accompanying text.
15. *See, e.g.*, Banner Metals, Inc. v. Lockwood, 3 Cal. Rptr. 421 (Dist. Ct. App. 1960).
16. *See, e.g.*, United States v. Dubilier Condenser Corp., 289 U.S. 178 (1933); Solomons v. United States, 137 U.S. 342 (1890); Wommack v. Durham Pecan Co., 715 F.2d 962 (5th Cir. 1983). *See generally* Scott P. Sandrock, *The Evolution and Modern Application of the Shop Right Rule*, 39 BUS. LAW. 953 (1983).
17. *See infra* Part IV.A.2.

in both cases. However, legislation in eight states regulates employment contracts so that even R&D employees own unrelated inventions made off-site.[18]

The three default rules are summarized in Table 1.

Type	Invention Status	Ownership
Firm-owned	Inventor "employed to invent"	Firm owns outright
Firm-related	Non-R&D inventor; invention related to employee duties or created with employer resources	Split entitlement: employee owns patent, but firm has "shop right," a limited, nontransferable license
Independent	Invention unrelated to employee duties or created without employer resources	Employee owns outright

Table 1: Legal Overview

B. The (Almost Complete) Primacy of Contract

Because the default rules award ownership to employees in some cases, employers routinely require new R&D employees to pre-assign title to future inventions. Many employers also require such contracts from non-R&D employees. This makes sense in light of trends toward participatory manufacturing, employee empowerment, and developments designed to reduce hierarchy and capture the knowledge of front-line workers.[19] A typical pre-employment contract assigns title to any invention made during employment to the employer firm. However, statutes in eight states limit the scope of the firm's claims,[20]

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18. *See infra* notes 30–32 and accompanying text.

19. *See, e.g.*, Michael P. Cronin, *Asking Workers What They Want*, INC., Aug. 1994, at 103 ("We own 12 patents that came out of workers' participation."); Michael A. Verespej, *Tenneco Packaging*, INDUSTRY WK., Oct. 21, 1996, at 60 (describing pervasive program of employee participation in improving operations of linerboard mill).

20. *See infra* notes 30–32 and accompanying text.

and employees in egregious cases may invoke an implicit public policy requiring reasonableness in assignments.[21]

Aside from these relatively minor qualifications, employers have broad powers — consistently upheld by the courts — to claim employee inventions by contract. In addition, these contracts usually impose several related duties on employees, including (1) a duty to assign patent applications and patents to the employer, (2) a duty to assist in the patent prosecution, and (3) a general duty to cooperate in the perfection of the employer's rights in the invention.

In general, courts interpret these contracts in favor of the employer. Although employees may be discharged at any time, courts uniformly hold that even a brief period of continued employment after the signing of a pre-invention contract constitutes legal consideration for the employee's assignment of rights in future inventions.[22] Despite the apparent disparity in bargaining power, pre-invention agreements are almost always enforced over objections that they are unconscionable, were coerced under duress, or are contracts of adhesion.[23] Assignments of completed inventions are routinely enforced despite nominal consideration as low as $1.[24] Courts stretch to make these contracts binding even when they are not signed at the commencement of employment,[25] they expire before the end of employment,[26] they are signed after an employee has invented,[27] or they otherwise fail to satisfy the traditional requirements for a binding contract. As with the default rules governing employee inventions, the deck is stacked quite heavily

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21. Employees relying on "reasonableness" claims might draw analogies from the law of post-employment noncompetition agreements and trade secret nondisclosure agreements. *See, e.g.*, Guth v. Minnesota Mining & Mfg. Co., 72 F.2d 385 (7th Cir. 1934) (invalidating, as contrary to public policy, part of employment agreement that was limitless in time and subject matter); Aspinwall Mfg. Co. v. Gill, 32 F. 697 (C.C.D. N.J. 1887) (invalidating agreement to assign all future inventions, whether made during or after employment (!)).

22. *See* Cherensky, *supra* note 1, at 623.

23. Although unconscionable contracts are not enforceable, courts do not generally view these pre-invention contracts as unconscionable. Contracts of adhesion are generally enforceable so long as they are not unconscionable. *See, e.g.*, Cubic Corp. v. Marty, 229 Cal. Rptr. 828, 833–34 (Ct. App. 1986); Cherensky, *supra* note 1, at 600.

24. *See, e.g.*, Mosser Indus. Inc. v. Hagar, 200 U.S.P.Q. (BNA) 608 (Pa. Ct. C.P. Lehigh County 1978); John P. Sutton, *Compensation for Employed Inventors*, 1975 CHEMTECH 86, 88 ("[Fifty-four percent] of the [162 employed] inventors [surveyed] received $1.00 or less in direct compensation for their inventions," even though 19% estimated the value of their inventions at over $1 million).

25. *See, e.g., Cubic*, 229 Cal. Rptr. at 834.

26. *See, e.g.*, Toledo Mach. & Tool Co. v. Byerlein, 9 F.2d 279 (6th Cir. 1925); Aerial Prods., Inc. v. Anzalone, 163 N.Y.S.2d 287 (Sup. Ct. 1957).

27. *See, e.g.*, Harsco Corp. v. Zlotnicki, 779 F.2d 906 (3d Cir. 1985); Georgia-Pacific Corp. v. Lieberam, No. 1:89-CV-0801, 1990 U.S. Dist. LEXIS 19918, at *17 (N.D. Ga. June 1, 1990).

in favor of employers.[28] Only in the most egregious situations will courts modify or rescind such a contract.[29]

There are *some* limits, however. For example, between 1977 and 1989, eight states passed legislation limiting employers' ownership claims over employee inventions.[30] California's statute, which is typical, renders unenforceable contracts assigning rights in inventions that an employee "developed entirely on his own time without using the employer's equipment, supplies, facilities, or trade secret information."[31] The California statute, like most of these statutes, provides employers an exception for (1) inventions that "[r]elate . . . to the employer's business, or actual or demonstrably anticipated research or development," and (2) inventions that "[r]esult from any work performed by the employee for the employer."[32]

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28. *See, e.g.*, Cherensky, *supra* note 1, at 599; William P. Hovell, Note, *Patent Ownership: An Employer's Rights to His Employee's Invention*, 58 NOTRE DAME L. REV. 863, 875–80 (1983); Henrik D. Parker, Note, *Reform for Rights of Employed Inventors*, 57 S. CAL. L. REV. 603 (1984).

29. For example, in the famous *Sears* case, a low-level Sears employee invented the "quick-release" socket wrench and was induced to assign rights in it to Sears after Sears officials, fully cognizant of its multi-million dollar appeal, told him it was worth only $10,000. *See* Roberts v. Sears, Roebuck & Co., 573 F.2d 976 (7th Cir. 1978). In this highly unusual case, the court gave $1 million in socket wrench royalties to the employee-inventor.

30. *See* CAL. LAB. CODE § 2870 (West 1989) (enacted 1979); DEL. CODE ANN. tit. 19, § 805 (1995) (enacted 1984); 765 ILL. COMP. STAT. 1060/2 (West 1998) (enacted 1983); KAN. STAT. ANN. § 44-130 (1993) (enacted 1986); MINN. STAT. § 181.78 (1998) (enacted 1977); N.C. GEN. STAT. §§ 66-57.1 to 66-57.2 (1992) (enacted 1981); UTAH CODE ANN. § 34-39-3 (1997) (enacted 1989); WASH. REV. CODE § 49.44.140 (1990) (enacted 1979).

31. CAL. LAB. CODE § 2870(a).

32. *Id.* § 2870(a)(1)–(2). The full provision reads:

> § 2870. Employment agreements; assignment of rights
>
> (a) Any provision in an employment agreement which provides that an employee shall assign, or offer to assign, any of his or her rights in an invention to his or her employer shall not apply to an invention that the employee developed entirely on his or her own time without using the employer's equipment, supplies, facilities, or trade secret information except for those inventions that either:
>
> (1) Relate at the time of conception or reduction to practice of the invention to the employer's business, or actual or demonstrably anticipated research or development of the employer.
>
> (2) Result from any work performed by the employee for the employer.
>
> (b) To the extent a provision in an employment agreement purports to require an employee to assign an invention otherwise excluded from being required to be assigned under subdivision (a), the provision is against the public policy of this state and is unenforceable.

Id. § 2870. A related provision requires an employer to give notice of this section in contracts concerning employee inventions. *See id.* § 2872. The counterpart provision in

Federal legislation introduced in the late 1970s would have gone further. The proposed legislation would have eliminated all pre-invention assignments and stipulated that employees hold title to all inventions, with assignments available only on an ex post basis. Wisely, this legislation was defeated; the bargaining problems that would have resulted[33] were apparent at least to some.[34]

III. CRITICISM OF THE LEGAL RULES

Few academic commentators have had anything good to say about the law of employee inventions. The position taken by an article in the trade journal *Machine Design* is typical.[35] The author asserts that the current regime of employer ownership "drain[s] a person's productivity in the same manner that communist countries stifled their workers [sic] will to produce."[36] "Allowing business to exploit their employees by assuming rights to their inventions," the author continues, "is morally and ethically wrong."[37] Another commentator[38] advocates rules that grant employee-inventors ownership in some cases and require administratively-determined compensation in others.[39] Other commentators echo the sentiment.

Washington State, *see* WASH. REV. CODE § 49.44.140(3), has been strictly applied. *See* Machen, Inc. v. Aircraft Design, Inc., 828 P.2d 73 (Wash. Ct. App. 1992) (holding invention and confidentiality agreement void because it failed to give written notification to employee as required by statute).

33. *See infra* Part IV.A.

34. *See, e.g.*, Donald G. Manly, *Inventors, Innovators, Compensation and the Law*, RES. MGMT., March 1978, at 29, 30–31.

35. *See* Riley, *supra* note 1.

36. *Id.* at 109.

37. *Id.*

38. *See* Parker, *supra* note 28, at 617–22.

39. In a related vein, another commentator argues that "the property rights in preinventions should be disaggregated and allocated between employee-inventor and employer according to the interests of each." Cherensky, *supra* note 1, at 601. Specifically, the author calls for the creation of a "reverse shop-right," an "inalienable" right which "would permit employee-inventors to make, use, and sell their invention outside the employment relationship." *Id.* at 662. This right would permit the employee-inventor to develop the invention commercially and to create new inventions dependent upon the original. *See id.* at 664. (This is very similar to an idea first put forth by Hovell, *supra* note 28, at 887–88.) Because a highly complementary invention would not have much independent value, this proposal would probably not affect the property-rights based analysis in this Article. Such a rule might create some incentive problems, however. Too great an incentive to invent "for one's own account" — which the reverse shop-right might entail — would tend to create a suboptimal mix of job tasks on the part of the rational employee. The only court to consider a "reverse shop-right" claim rejected the argument, although it did not mention these considerations. *See* Mainland Indus., Inc. v. Timberland Mach. & Eng'g Corp., 649 P.2d 613 (Or. Ct. App. 1982) (emphasizing employer's significant investment in invention).

The historian David Noble[40] traces the emergence of strong employer-ownership rules in the United States and criticizes what he considers to be their central role in the trend toward corporate control of research. Noble writes that the rules were understood at the beginning of this century as "amount[ing] to confiscation" and went a long way toward "subverting the intent of the patent system."[41] He concludes:

> The successful reform efforts between 1900 and 1929 . . . brought the American patent system more closely into line with the needs of corporate industry. They set the basis for a "formalism" in the handling of patents which progressively eliminated the individual inventor, who, unlike the large corporations with their well-staffed legal departments, was not equipped to cope with its intricacies and complexities. . . . [T]he new formalism . . . well served the interests of both the corporations and the lawyers. The changes in the mechanism of the patent system, coupled with the emergence of corporate patent monopoly and industrial research, presented a formidable obstacle to the individual inventor . . . .[42]

An otherwise balanced account of the same period also suggests a lessening of employee incentives: it is entitled "Removing the 'Fuel of Interest' from the 'Fire of Genius': Law and the Employee-Inventor, 1830–1930."[43]

Diagnoses and prescriptions differ, but virtually all serious accounts of the rules share the same normative conclusion: current regulations are unfair to employees, egregiously one-sided in favor of employers, and ought to be changed.[44] Often the proposed solution is to bring U.S. law more in line with European law. This might be accomplished by making employee ownership the default rule or by establishing a system to compensate employees fairly, similar to that used in Germany.[45]

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40. *See* NOBLE, *supra* note 1.

41. *Id.* at 90.

42. *Id.* at 108–09.

43. Fisk, *supra* note 12. The title alludes to a famous quotation by Abraham Lincoln that the patent system rewards "freedom of thought" by adding "the fuel of interest to the fire of genius."

44. *See, e.g.*, Bartow, *supra* note 1, at 675–77; Neal Orkin, *Rewarding Employee Invention: Time for Change*, HARV. BUS. REV., Jan.–Feb. 1984, at 56; Cherensky, *supra* note 1, at 597; Parker, *supra* note 28, at 604–06; Riley, *supra* note 1, at 109.

45. *See* Matthias Ruete, *The German Employee-Invention Law: An Outline*, *in* EMPLOYEES' INVENTIONS: A COMPARATIVE STUDY 180, 197–200 (Jeremy Phillips ed., 1981); *see also* Orkin, *supra* note 44, at 57; Parker, *supra* note 28, at 614, 616–17.

IV. WHY THE CRITICS ARE WRONG: THE ECONOMICS OF EMPLOYEE INVENTIONS

Courts justifying the default rules for invention ownership seldom articulate the problems that would follow from widespread employee ownership of inventions. If they did, they might well cite one of four distinct inefficiencies: (1) bargaining and transaction costs, particularly employee holdups; (2) the difficulties of monitoring and compensating the members of R&D groups; (3) principal-agent problems, in particular the danger that employee ownership would over-reward inventive tasks at the expense of other job requirements; and (4) a change in the implicit risk allocation between employer and employee.

A. Holdups in Employee-Employer Transactions

At the most basic level, the difference between employer and employee ownership is a matter of transaction costs. Employer ownership is more efficient for two transaction-related reasons: (1) it occurs at the commencement of employment and thus is far simpler than deals struck after an employee makes a specific invention; and (2) it eliminates the possibility of holdups by employee-inventors, thereby making it more attractive for a firm to invest in R&D by employees in the first place.

In the conventional arrangement, employee contracts function as "pre-assignments": they are signed at the commencement of employment and therefore before any inventions have been made. Thus, when employees do come up with inventions, under the law the employer firm *already owns the invention*.

Pre-assignment to a single entity avoids holdup costs. A "holdup," in economic parlance, occurs whenever one person extorts abnormally large amounts of money from another person.[46] The classic example is the owner of one parcel of land in the middle of a large tract comprising many individual, identical parcels. The potential for holdup emerges when a developer comes up with a plan to aggregate all the parcels into a single tract that is more valuable than the sum of the values of the individual parcels. If the developer acquires all but the last parcel needed to realize the valuable development project, the owner of that last parcel can extract from the developer an amount much larger than what the single parcel would have fetched in a normal transaction. The price of the last parcel will approach the greater of (1) the developer's expected profit from the project and (2) the amount the developer would

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46. *See* PAUL MILGROM & JOHN ROBERTS, ECONOMICS, ORGANIZATION AND MANAGEMENT 599 (1992) (defining "holdup").

lose if he had to abandon the project and begin again somewhere else. In such a case, the owner of the last parcel has a "holdup right."[47]

Holdups are common in the intellectual property context because discrete intellectual property rights often cover individual components of a complex, multicomponent product. An individual intellectual property rightsholder can follow the same strategy as the owner of the last parcel of land in the earlier example: if a manufacturer wants to develop a new product, the rightsholder can extract much of the value of the final product by waiting until all the other rightsholders have granted licenses to the manufacturer. Many employee inventions fit this pattern: they are one component of a complex, multicomponent product whose total market value often far exceeds the value of the component standing alone. As a result, the associated patents could serve as the basis of a holdup strategy *if* the patents were owned by individual employees. The prevailing rule of employer ownership prevents this result, and thus makes good economic sense.

If employees were able to hold up the employer firm, the ex ante consequence might be underinvestment in R&D. A holdup right depends on a high degree of complementarity between the assets owned by the investing party and the key input owned by the person with the holdup right. Research and development creates highly complementary assets and thus increases the risk of holdup.[48] Common ownership of complementary assets solves the holdup problem and promotes socially beneficial activities, such as R&D.

1. A Hypothetical Example

Often the potency of a holdup right grows as the target of the strategy — the prospective buyer of the right — invests more money in the project. Suppose, for example, that employee A works for a

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47. *See* Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1106–07 (1972) (illustrating desirability of "liability rule," such as eminent domain, over absolute "property rule" by giving example of sale of small parcels of land to buyer who needs all parcels).

48. Note the tendency of empirical studies to *equate* high R&D intensity with high levels of asset specificity, which implies that more R&D creates more opportunity for employee holdups. *See* Howard A. Shelanski & Peter G. Klein, *Empirical Research in Transaction Cost Economics: A Review and Assessment*, 11 J.L. ECON. & ORG. 335, 343 (1995); *see also* Henry O. Armour & David J. Teece, *Vertical Integration and Technological Innovation*, 62 REV. ECON. & STAT. 470 (1980); Steven Globerman, *Markets, Hierarchies, and Innovation*, 14 J. ECON. ISSUES 977 (1980); Paul L. Joskow, *Vertical Integration and Long-term Contracts: The Case of Coal-burning Electric Generating Plants*, 1 J.L. ECON. & ORG. 33 (1985); Gary P. Pisano, *Using Equity Participation to Support Exchange: Evidence from the Biotechnology Industry*, 5 J.L. ECON. & ORG. 109 (1989).

snowboard manufacturing company that permits its employees to retain sole ownership of job-related inventions. A is assigned to design a new type of snowboard binding. When he has completed the design, he receives a patent for it. Excited by the prospect of an innovative binding, the snowboard company ramps up for production of snowboards incorporating the new binding system. But first, it must acquire A's patent rights, either by assignment or license. A's best strategy at this point is to hold up the firm for as much of its expected profit as he can. If, prior to negotiating with A, the firm has invested $1 million in specialized production equipment for the new binding, A will be able to hold up the firm for $1 million, or close to it. Assuming that the expected economic benefit to the firm of A's invention is small relative to the firm's investment, it is easy to see from this example why someone in A's position is said to hold up the acquiring firm.[49]

If the snowboard firm has been through this before with other employees, it may wait before ramping up production for the new design. After all, it is the firm's sunk cost in the specialized production equipment that gives A his bargaining leverage. If the firm waits, A's leverage is reduced. But note that this may be costly. If rapid product introduction is more profitable — increasing, for example, the firm's lead time before other companies can invent around A's patent and introduce a competitive binding — then waiting dissipates some of the benefits of the new design.

Adding realistic complexity creates even more problems in the holdup game. Assume that A is part of a research team that also includes B and C. The snowboard manufacturer wants to create an entirely new binding system. B is given the task of investigating new plastic materials to use in the binding straps and buckles. C is told to work on new fastenings to attach the bindings to the snowboard. If each employee is given ownership of his invention, a costly dynamic can result. If employee A is smart, he will extend his negotiations until after the firm has acquired rights from B and C. By waiting, he can position himself to play the holdup game described above. Assuming the same $1 million in sunk costs, if the first two inventors received $100,000 each for their rights, employee A can demand $800,000.[50] Of course,

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49. *Cf.* Robert P. Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75 (1994) [hereinafter Merges, *The Case of Blocking Patents*] (describing related case of holdup by owner of basic patent in negotiating with "radical improver" having patent of his own).

50. Note that the holdups can occur even if the inventions do not depend on each other, provided that the same costs are sunk in reliance on all of them. For example, suppose that B's new plastic would be equally valuable with bindings of any design, old or new. If the firm must invest $1 million in setting up an assembly line, and must decide ahead of time both which plastic and which type of binding it will use, any one of the inventors will be able to hold up the firm.

looking ahead, all three inventors will see that waiting is a profitable strategy, creating even more bargaining problems and further delaying the moment when the firm can safely invest in production of the new binding system.[51]

The example illustrates some simple dynamics of holdups and shows why the law often assigns ownership to employers. The employer's contracts with A, B, and C ensure that the firm can use the three inventors' output in the firm's snowboard production process. Put another way, when a manager breaks a research problem down into components and assigns each to an employee, this reflects an implicit assumption that the firm will be able to use the resulting product design. The knowledge that the firm will own A's component permits it to assign responsibility for the other components to B and C. Common ownership also allows B and C to work closely with A in adapting the three components to work together. In addition, the assumption of common ownership gives the firm's managers freedom of action. They can begin investing in specific production machinery adapted to a component's design, even before the design is finalized. They can also pass along information about the new product to the marketing department, which can both begin to figure out how to sell the product and provide feedback regarding refinements and enhancements.

If individual employees owned their own inventions, the process would be much more complicated. The firm's managers would take a risk if they invested in production and marketing before acquiring the rights to all the components. Each dollar invested would only add to the bargaining position of the employees who still had rights to their respective components. In an extreme case, if the invention were completely unique (i.e., without substitutes in the market), each dollar invested would go directly to the employees, because without the rights to the components the investments would be worthless. The employees could hold up the firm for the full value of its investment.

Knowing this in advance, a rational firm would either undertake less R&D or radically redesign the R&D process. The firm might direct

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On the other hand, if the inventions are only useful in combination, the situation can be even worse. In that case, the amount spent buying rights to the first two inventions can itself be a sunk cost with respect to the third. If, by refusing to license, A could render the $200,000 invested in the inventions of B and C totally useless, and the firm cannot rescind its $200,000 investment, then a rational firm theoretically would be willing to pay A not just $800,000 but $1,200,000.

51. All three inventors might play the holdup game by trying to be the last to sign the agreement. In addition, each might spend time and money trying to convince the employer that his patented component is more important than the others' and hence deserves a larger share of the total proceeds. This might well dissipate some of the expected gains from holding out and in any event would be a major diversion away from efforts to complete and perfect the invention.

employees to design very generic components, similar to other designs available in the market, in order to constrain the bargaining power of employees once they had made an invention. This, of course, has drawbacks. First, it would reduce the distinctiveness of each firm's products. Second, it would encourage each employee to design a component that had maximum sales potential as an individual component, which might well hurt the performance of the firm's specific product.

In principle, there is no reason why the holdup problem could not be solved with a contract awarding ownership to an employee. All that is required for an ex ante contract to avoid holdups is that the compensation for a license be fixed, so that the inventor cannot use his property right to extract excessive rents from the other party to the transaction.[52] Two observations are in order, however, regarding the apparent absence of ex ante contracts awarding ownership to employees.

First, the parties to such a contract would have to sign it before any details of the invention were known — indeed, before anyone knew whether a particular employee would ever invent anything at all. Under these circumstances, given the risk aversion typical of individuals, an employee would likely place a relatively low ex ante value on the right to this compensation. Indeed, it is arguable that current salaries for R&D employees are a precise measure of the expected, risk-adjusted present value of all future employee inventions. Making employees' compensation depend meaningfully on their inventive success would simply transfer the risk of inventive failure away from employers, who, as a class, are more efficient bearers of this risk.

Second, many companies do use something that is at least analogous to an ex ante compensation agreement for inventive employees: employee reward plans.[53] These programs are structured to provide a reward to creative employees, but in a way that eliminates the holdup risk that attends individual ownership.

2. Holdups and Default Rules: The Shop Right

Recall that in the case of "firm-related" inventions by non-R&D employees, courts often award a divided entitlement: the employee owns the invention, but subject to a shop right in favor the firm.[54] Is there a

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52. Since the only purpose of fixing the license fee is to avoid the need for ex post bargaining, the fee could be fixed in some way other than as a specified dollar amount — for example, as a percentage royalty on sales.

53. *See infra* Part V.A.

54. *See supra* Part II.A.2.

justification for this entitlement structure, and what incentives does it create?[55]

The justification for shop rights mirrors the general case for employer ownership. In awarding shop rights, the law asks primarily whether the employee used firm resources. Given that these resources typically include firm machinery, labs, processes, and personnel, the legal test appears to be a fair proxy for the complementarity between the invention and the firm's other assets.[56] Certainly it is true that inventions created with firm resources are more likely to be complementary: inventions completely unrelated to a firm's business can just as easily be made away from the job site, and many employees seem to know, or at least intuit, that developing ideas at work subjects them to stronger firm ownership claims. As explained earlier, it is precisely when inventions are complementary to a firm's assets that divided ownership is most likely to create holdups.[57] The shop rights doctrine addresses this concern by giving the firm a partial interest in the invention — enough of an interest to use it without negotiating with the ex-employee. This prevents the possibility of a holdup by the employee and consequent underinvestment in R&D by the firm.

By the same token, courts recognize that without a shop right employees would have some worrisome ex ante incentives. As one court put it in refusing to limit the right of an employer to use only actual machines that the ex-employee constructed during employment:

> To have limited the license to the use of a single machine, rather than to the practice of the invention within the reasonable requirements of the master's business, would have placed the trade which both the master and the servant sought to develop at the mercy of the owner of the patent, as soon as the business had

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55. The discussion here differs from that in Anton & Yao, *supra* note 2, which discusses employee incentives to leave an employer firm to found a start-up. Anton and Yao assume a weak or nonexistent property right (e.g., trade secret law, as opposed to patent law) covers the employee invention, which makes their discussion of shop rights — a divided property entitlement — idiosyncratic. In any event, the key role of the shop right in their analysis is to eliminate the possibility that an employee can exit the firm surreptitiously with the invention and establish a monopoly position in the market for the invention. In their analysis, this makes an employer-backed spinoff the most likely outcome. *See id.* at 376.

56. Aghion and Tirole explain shop rights as an efficient split entitlement when both the employer and employee must invest in making the invention. *See* Philippe Aghion & Jean Tirole, *The Management of Innovation*, 109 Q.J. ECON. 1185, 1199 (1994). Their argument, based on ex ante incentives to invest, is entirely consistent with the view taken here, which emphasizes the inefficiency of ex post holdup. Clearly, expectations about tomorrow's holdup problems are deeply intertwined with today's incentives to invest.

57. *See supra* Part IV.A.

> grown, or the art had advanced to such an extent as to make inadequate or obsolete the original mechanical construction which embodied the invention.[58]

The law precludes holdup, in other words, by granting an entitlement that leaves *neither* party at the mercy of the other.

Support for the split entitlement solution is found in the common practice of contracting for joint ownership. In an empirical study of R&D-intensive technology-alliance contracts in the biotechnology industry, 72% of the contracts gave the financing firm at least partial ownership of inventions resulting from the biotechnology firm's research.[59] The figure was close to 80% for very recent deals.[60] At the same time, very few of these contracts — roughly 10% — awarded ownership outright to the financing firm.[61] Clearly joint ownership is the most common solution.

If most negotiated contracts result in joint ownership, then it would make sense for the law to adopt joint ownership as the default rule when the circumstances surrounding invention mirror those of a technology alliance. Generally, a technology alliance requires both parties to make substantial investments to reach a desirable result. The case law on shop rights appears to approximate a default rule of joint ownership. Inventors working on problems outside their scope of employment are by definition making an unusual effort: they are investing time and energy above and beyond the normal call of duty. At the same time, shop rights are only awarded when this extraordinary effort is applied using tools and resources owned by the employer. These, of course, require substantial investments by the firm. Use of the employer's assets also makes it likely that the resulting invention will be adapted to the firm's line of business or preexisting technology — i.e., it likely will be highly complementary with those assets. Since separate ownership of complementary inventions would pose a serious ex post holdup problem,

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58. Tin Decorating Co. of Baltimore v. Metal Package Corp., 29 F.2d 1006, 1008 (S.D.N.Y. 1928); *see also* Gemco Eng'g & Mfg. Co. v. Henderson, 84 N.E.2d 596, 601–02 (Ohio 1949) (Taft, J., dissenting) (describing shop right rule as "refusing to help the employee bite the hand that fed him"). Note the slight difference between this rationale and that in Aghion & Tirole, *supra* note 56, at 1200–01, which explains shop rights as a split entitlement that preserves the incentives of employees who make inventions that have multiple prospective licensees, or customers. The analysis by Aghion and Tirole applies more naturally to an independent R&D contractor — which does seem to be the more central case in their approach — than to employees.

59. *See* Josh Lerner & Robert P. Merges, *The Control of Technology Alliances: An Empirical Analysis of the Biotechnology Industry*, 46 J. INDUS. ECON. 125, 143 tbl.V (1998) (sampling 200 technology alliances between 1980 and 1995).

60. *See id.*

61. *See id.*

a split entitlement — in the form of the shop right — makes a good deal of sense.

Recent theory on default rules provides an independent basis for shop rights. Ian Ayres and Rob Gertner have described a class of "penalty defaults," legal rules designed to encourage one party to disclose value-adding information to another party.[62] The idea is to use defaults not as proxies for what parties would have agreed to, but rather as a way to force disclosure of information. The idea is simple: if one contracting party does not like how it will fare under a default rule, it will override that rule explicitly with a contrary provision in a written contract. Such an explicit provision can reveal valuable information to the other contracting party. For example, if a default rule harshly penalizes a contracting party for failing to perform one aspect of the contract, altering that default rule may signal that the party in question expects to have trouble performing that part of the contract. At a minimum, the penalty default puts the other party on notice by calling attention to a particular term in the contract.

Under the theory of penalty defaults, shop rights could be explained as a default that encourages firms to bargain explicitly over ownership at the outset of a relationship with an inventive employee, consultant, or contractor. To the extent that a firm prefers to own an invention outright, it would have to negotiate up front with a potential inventor who might be assigned title. (This argument holds equally well when an employee, consultant, or contractor would be what was described earlier as an "independent inventor,"[63] i.e., would hold full title without being subject to a shop right.) By bargaining over prospective ownership, in other words, the firm would signal to the employee, consultant, or contractor that he may be involved in important inventive work. This could be useful information during salary negotiations, for example. At a minimum, the provision informs potential inventors — perhaps for the first time — that in the absence of a contract, they might have a claim to title for inventions resulting from the relationship.[64]

It is interesting to note that the same logic applies to the case of co-owners of a patent. Unlike copyright law, in which co-owners of a

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62. *See* Ian Ayres & Robert Gertner, *Filling Gaps in Incomplete Contracts: An Economic Theory of Default Rules*, 99 YALE L.J. 87 (1989). Note that the value of a penalty default disappears if the disclosure of information comes by way of a form contract that nobody ever reads, or if damages for breach of the contract are uncertain, *see* Barry E. Adler, *The Questionable Ascent of* Hadley v. Baxendale, 51 STAN. L. REV. 1547 (1999).

63. *See supra* Part II.A.3.

64. In fact, though, *employees* seem to understand that employers own the vast majority of inventions by default anyway. If so, it is difficult to argue that assignment contracts reveal important negotiating information to prospective employees in the sense of an Ayres-Gertner penalty default. *See* Ayres & Gertner, *supra* note 62, at 95.

copyright who independently exploit a co-owned work must account to the other owners, under patent law, co-owners can each exploit an invention with no obligation to the others. This places a premium on ex ante agreement,[65] which is arguably one rationale for the rule. By permitting parties to harm each others' prospects severely in the absence of agreement, patent co-ownership rules make it more likely that parties will write a comprehensive contract in advance. In addition, a party that insists on such a contract is signaling to the other party that it values certainty and exclusivity very highly — potentially valuable information when the parties negotiate how to split the profits from the patent.

B. Team Production Theory

The snowboard example can be used to illustrate another feature of corporate invention that employer ownership appears well suited to address. Assume that, as a result of the binding system developed jointly by A, B, and C, the employer firm is able to charge a higher price for its snowboards, resulting in greater profits. Although it is clear that the new binding system has made these additional profits possible, determining how much of the added profit to attribute to each of the individual components would be very difficult.[66] After all, the components were designed to work together; selling a version of the bindings that omitted any one component might be difficult or even impossible. In this setting it is impossible to determine precisely what contribution each of the three components — the inputs — makes to the final product — the output.[67]

How common is the team production dynamic in industry? Very common, according to the literature on firm-level R&D and research

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65. *See generally* Robert P. Merges & Lawrence A. Locke, *Co-Ownership of Patents: A Comparative and Economic View*, 72 J. PAT. & TRADEMARK OFF. SOC'Y 586 (1990).

66. *See* Armen A. Alchian & Harold Demsetz, *Production, Information Costs, and Economic Organization*, 62 AM. ECON. REV. 777 (1972); *see also* HAROLD DEMSETZ, THE ECONOMICS OF THE BUSINESS FIRM (1995).

> A team aspect to production arises as a result of . . . interdependencies [between management and labor]. This synergistic interaction makes it difficult, even impossible, to isolate the contributions to the value of output purely attributable to a single input. In addition to creating this measurement problem, synergism may enhance the productivity of team organization as compared to persons acting on their own as production units.

Id. at 18.

67. Indirect evidence of the difficulty of valuing individual components in a complex system comes from the knotty and challenging law of patent damages. For general background on how courts determine a patentee's damages when the patented item is one component in a complex system, see ROBERT P. MERGES, PATENT LAW AND POLICY 1006–84 (2d ed. 1997).

engineers' accounts of what they actually do. There is abundant evidence that many if not most firm-sponsored inventions are complementary with those of other employees. Consider:

- the emphasis on facilitating teamwork in the literature on R&D management and in patent law doctrines;[68]
- the emphasis on managing highly complementary components of R&D projects;[69]
- the frequency of multiple patents and associated patent-related trade secrets and know-how in licensing transactions;
- the grave concern with employee turnover in the R&D management literature and the associated discussion of firm-specific learning curves; and
- the large proportion of patents naming more than one employee as inventors.

Books describing the process of corporate research lend additional support to the notion that research teams are ubiquitous.[70] Engineering managers break a design task down into discrete subtasks and assign individuals and groups to solve each problem.[71] The resulting

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68. *See, e.g.*, 35 U.S.C. § 116 (1994). Section 116 provides in pertinent part:

> Inventors may apply for a patent jointly even though (1) they did not physically work together or at the same time, (2) each did not make the same type or amount of contribution, or (3) each did not make a contribution to the subject matter of every claim of the patent.

Id. The legislative history of the amendment "recognizes the realities of modern team research. A research project may include many inventions. Some inventions may have contributions made by individuals who are not involved in other, related inventions." 130 CONG. REC. H10,525 (daily ed. Oct. 1, 1984), *reprinted in* 1984 U.S.C.C.A.N. 5827, 5834 (section-by-section analysis of Patent Law Amendments of 1984).

69. *See, e.g.*, Arthur N. Chester, *Measurement and Incentives for Central Research*, RES.-TECH. MGMT., July–Aug. 1995, at 14; Edward J. Delaney, *Technology Search and Firm Bounds in Biotechnology: New Firms as Agents of Change*, 24 GROWTH & CHANGE 206 (1993); Gary P. Pisano, *The Governance of Innovation: Vertical Integration and Collaborative Arrangements in the Biotechnology Industry*, 20 RES. POL'Y 237 (1991).

70. *See, e.g.*, LOUIS L. BUCCIARELLI, DESIGNING ENGINEERS 141 (1994) (describing tasks and sub-tasks assigned to various team members for specific R&D problem); WALTER G. VINCIENTI, WHAT ENGINEERS KNOW AND HOW THEY KNOW IT: ANALYTICAL STUDIES FROM AERONAUTICAL HISTORY (1990). According to Walter Vincienti, a prominent engineering professor at Stanford University, product design is divided up so that employees are responsible for portions of the firm's end product. *See id.* at 9. These divisions help to resolve technical problems in semi-isolation within well-defined and structured environments.

71. *See, e.g.*, JAMES L. ADAMS, FLYING BUTTRESSES, ENTROPY AND O-RINGS: THE WORLD OF AN ENGINEER 62 (1991) ("The formalization, discipline, and control [of the corporate engineering environment] are necessary in order to allow the organization to be stable and to allow projects to be broken down into jobs that can be accomplished within

components are then integrated into a single solution — the product of research teamwork.

Given that team production is indeed very common in corporate R&D activities, what follows from this? The economic literature provides several important insights. First, it would be difficult, at the outset, to write an enforceable contract setting forth precisely what each of the contributors is supposed to do. The components must work together, and the designs must all reflect that fact; but it would be difficult to specify precisely how they are to work together before they are actually built. This point is even more apparent when each of the *components* is designed by a team; returning to the snowboard example, there might be one group of people — call them the "A team" — responsible for the binding, another, the "B team," for the materials, and so on.

One common sense solution to this problem would be to assign each member of the inventive team a pro rata share of the increased profits generated by the team as a whole. Team production theory reveals that such a scheme encounters an obvious problem, however: if each employee is to receive one-third of the surplus no matter how hard he works, he has a natural incentive to relax and allow the other team members to do the lion's share of the inventive work. Economists call this "shirking" and use it to explain why managers are often necessary in firms where team production is the norm. The prospect of shirking explains why pro rata compensation — which really amounts to team ownership — would probably never work very well, particularly when the team has many members.[72]

Agreements from technology alliances reveal that parties occasionally will commit in advance to a reasonable split of the proceeds from any inventions made during the course of the relationship. Why are such agreements not observed in the case of the employed inventor? To begin with, the ex ante contract in the employment context would have to be signed right when the employee is hired. It is obviously very difficult for the employee to assess what inventions he might be capable of making at this point.[73] The employee would first need to learn about

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budgets and time limits."); BUCCIARELLI, *supra* note 70, at 141 (describing organizational hierarchy as fundamental to success of engineering research).

72. The more members on a team, the less each member's effort contributes to the overall value of the team result on average, the smaller his pro rata share of the final product, and the harder it is for the firm or other team members to monitor him to ensure he is working hard.

73. It is a different matter when a prospective employee comes to the firm with an invention (especially a patented one) *already in hand*. Numerous cases enforce licensing and assignment agreements in this context. *See, e.g.*, Dow Chem. Co. v. American Bromine Co., 177 N.W. 996 (Mich. 1920); Gross v. Diehl Specialties Int'l, 870 S.W.2d 246 (Mo. Ct. App. 1994); *cf.* Connors v. Howard Johnson Co., 571 N.E.2d 427 (Mass.

the employer's products or processes, but a great deal of the relevant information is in the form of trade secrets or tacit knowledge and know-how.[74] It is notoriously difficult to disclose this type of information in a bargaining context.

Furthermore, even if an inventor has a substantial amount of information, it will usually be quite difficult to predict the content of an invention beforehand. Most of the inventions under discussion are patentable. By definition, a patentable invention is one that entails a fair degree of ex ante uncertainty; this is what the legal requirement of nonobviousness, which applies to all patents, is all about.[75] Of course, the ex ante contract could specify numerous contingencies: if the employee invented something patentable, he would receive certain compensation; if it was a major invention, the compensation would be increased, etc. But the contingencies that might arise are both very numerous and very difficult (and expensive) to specify in great detail. This reality is therefore quite in tune with the literature of incomplete contracting, on which holdup analysis builds. One robust conclusion of this theory is that, in the presence of incomplete contracting, ownership matters.[76]

App. Ct. 1991) (employer has no property rights in invention conceived prior to employment).

74. Accounts of industrial R&D and invention almost universally mention the importance of hands-on experience, much of it gained over time and in the course of interactions with other researchers, manufacturing personnel, and marketing experts in the firm. *See* Charles E. Bosomworth & Burton H. Sage, Jr., *How 26 Companies Manage Their Central Research*, RES.-TECH. MGMT., May–June 1995, at 32; Chester, *supra* note 69; Samuel R. Phillips, *What Is an Inventors'* [sic] *Fair Share?*, MACHINE DESIGN, Oct. 26, 1995, at 163 [hereinafter Phillips, *What Is an Inventor's Fair Share?*].

75. *See* Robert P. Merges, *Uncertainty and the Standard of Patentability*, 7 HIGH TECH. L.J. 1, 34 (1993).

76. Ex ante agreements to split the surplus from R&D investments are common in one setting: joint ventures. But joint ventures are quite different from arm's length negotiations. Each party to a joint venture continues to play a management and oversight role. Because joint ventures permit ongoing monitoring, it is difficult for one of the parties to manipulate the venture so as to hold up the other. *See* DAVID C. MOWERY & NATHAN ROSENBERG, TECHNOLOGY AND THE PURSUIT OF ECONOMIC GROWTH 246 (1989).

> Partner firms make financial commitments to a collaborative venture that back their claims for the value of the assets they contribute . . . .
>
> . . . [M]onitoring the behavior of the recipient of technology within a joint venture reduces the risk that the transferor will not benefit from any improvements in transferred technology made by the recipient.

Id.

In addition, joint venture agreements usually provide for some sort of joint ownership arrangement for newly discovered inventions, which makes it less likely that one of the parties will be able to hold up the other. Indeed, the law of joint patent ownership allows each party to exploit a patented invention without consulting with or

Having said this, there are two ways in which inventions can be the subject of what might loosely be called contingent valuation agreements. First are employee reward systems, discussed later in this Article.[77] An employee who signs on with a company that publicizes such a plan is opting into an agreement to submit any inventions to the operation of the plan. Thus while specific, detailed, contingency contracts are not possible, there is a generalized agreement to a compensation procedure whenever an employee joins a company in reliance on such a plan. This is one reason why judicial enforcement of these plans makes sense.

There is a second commonly observed practice that in some cases amounts to contingent invention compensation: corporate spinoffs. It is not uncommon for a corporate employee to leave the firm and found his own company. Often the spinoff firm is begun specifically to take advantage of a technology first explored during employment with the firm. Spinoff investments often take the same form as venture capital investments, with the ex-employer acting the role of the venture capitalist. A common feature of these investments is for the startup firm to grant warrants, preferred stock, or the like to the investing entity. In many cases, the investing firm has the right to expand its ownership stake in the startup beyond some initial share.

When structured this way, corporate spinoffs are an example of a contingent ownership mechanism. Economists Georg Nöldeke and

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compensating the other party, making holdups virtually impossible. *See* Merges & Locke, *supra* note 65, at 596–97. Finally, joint ventures often require the partners to take an equity stake in each other (either directly, or indirectly through ownership of the joint venture entity). This brings the parties' incentives into closer alignment and precludes holdups, since these would be self-defeating, as one commentator makes clear:

> Contractual incompleteness and opportunities for strategic misrepresentation probably exist in most commercial contracts, but the magnitude of their effects in know-how contracts in the aluminum industry is potentially great. This is partly because it is so difficult to measure an intangible good, such as a service, and partly because of the enormous amounts of capital involved in plants such as refineries and smelters. It is probably impossible to harmonize fully the interests of the parties to such a contract, but considerable progress can be made in this direction if the parties internalize the transaction within a joint venture.
>
> The major advantage of this arrangement is that if the supplier of know-how has permanent equity in the plant, then he has an incentive to optimize its design and performance. The supplier can be compensated for his input with cash or a cash-free equity allocation. . . . [I]f the return on such an investment in technology comes in the form of a future stream of profits, the partner putting in the technology has a strong incentive to perform efficiently.

JOHN A. STUCKEY, VERTICAL INTEGRATION AND JOINT VENTURES IN THE ALUMINUM INDUSTRY 166–67 (1983).

77. *See infra* Part V.A.

Klaus Schmidt have recently described contingent ownership as a solution to a class of projects requiring specific investments by two contracting parties.[78] The Nöldeke-Schmidt model reveals that when two firms must sink relationship-specific investments in sequence to maximize the value of a joint project, optimal investment can be induced by giving one firm a contingent ownership claim over the project.[79]

For example, imagine two firms have decided to work together to build a new computer system that includes highly complementary components. One firm specializes in hardware, the other in software. If the hardware must be built first, the hardware firm might choose to limit its investment and thereby limit its potential for losses resulting from any subsequent failure by the software firm. The solution to the problem is to give the software firm an option to buy the joint project from the hardware firm at a set price. The price should be set so that selling the joint project at the agreed-upon price yields greater profit for the hardware firm than it could make by underinvesting. The option, if priced correctly, will induce the hardware firm to make the optimal investment. Once the hardware firm has made the optimal investment in creating the hardware, the software firm will complete the project by investing the appropriate amount in the software.

Some aspects of venture capital investments, including those made by firms as spinoff investments, reflect this design.[80] Most venture capital investments are structured to permit the venture fund to exercise some sort of option to increase its ownership stake in the startup firm.

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78. *See* Georg Nöldeke & Klaus M. Schmidt, *Sequential Investments and Options to Own*, 29 RAND J. ECON. 633 (1998).

79. *See id.* at 641.

80. *See* PAUL A. GOMPERS & JOSH LERNER, THE DETERMINANTS OF CORPORATE VENTURE CAPITAL SUCCESS: ORGANIZATIONAL STRUCTURE, INCENTIVES, AND COMPLEMENTARITIES (National Bureau of Econ. Research Working Paper No. 6725, 1998).

> Corporate venture investments in entrepreneurial firms appear to be at least as successful (using such measures as the probability of the portfolio firm going public) as those backed by independent venture organizations, particularly when there is a strategic overlap between the corporate parent and the portfolio firm. While corporate venture capitalists tend to invest at a premium to other firms, this premium appears to be no higher in investments with a strong strategic fit. Finally, corporate programs without a strong strategic focus appear to be much less stable, frequently ceasing operations after only a few investments, but strategically focused programs appear to be as stable as independent venture organizations. The evidence is consistent with the existence of complementarities that allow corporations to effectively select and add value to portfolio firms, but is somewhat at odds with the suggestion that the structure of corporate venture funds introduces distortions.

Id. at 34.

In recent years, corporate-based venture funds — those operating from inside large companies — have been growing; corporate investment has accounted recently for as much as 30% of all investment in new venture funds.[81] While corporate-based funds often invest in both spinoffs and outside firms, many make substantial spinoff investments. Indeed, these programs are often seen as the most effective response to the inevitable entrepreneurial urges of employees.[82]

C. Multi-Task Agency Models and Employee Incentives

This section considers another ex ante consequence of employee ownership of inventions: employees will maximize their own utility, rather than their employer's, which is problematic when employees have multiple responsibilities. This section focuses attention on the subset of employee inventions that meet two criteria from the perspective of firm management: (1) the inventions are worth pursuing despite divided ownership and (2) they are created by employees whose activities are difficult to monitor.

Some inventions are worth pursuing despite employee ownership: if the invention produces enough surplus, then both parties will invest in their respective assets despite an even split of the revenues. However, with employee ownership, some employees will divert their attention to create inventions that will be profitable (to them) ex post. Efforts to create these inventions will thus come at the expense of other work the employees might have been doing. Assuming — contra the *Dilbert* comic strip — that management knows better than R&D personnel the optimal mix of employee efforts, these inventions will come at the expense of other goals of the firm.

Employee ownership thus creates perverse incentives: when it is difficult to monitor employees closely, employees will maximize their own utility and not the firm's. In response to this dilemma, scholars of "job design," and "personnel economics" more generally, have described the ways that performance pay and monitoring can be tailored to bring employee incentives back in line with those of the firm. However, most R&D firms cannot solve their problems with mere performance pay and monitoring, due to the "multi-task principal-agent" problem:

> [P]aying for output alone encourages employees to ignore other valuable activities. Piece-rate workers will be tempted to reduce quality to increase measured

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81. *See id.* at 8 ("[C]orporate investors accounted for 30% of the commitments to new funds in 1997, up from an average of 5% in the 1990–1992 period.").

82. *See id.* at 13.

> quantity. They will be unlikely to help other workers if it means reducing their own measured output. . . . Moreover, unless they own the tools, equipment, and machines they use, they may fail to maintain these as well as the firm would desire because doing so takes them away from producing output.[83]

The same problem crops up with straight commission plans for salespeople.[84] Note how similar the "other" (slighted) activities of salespeople are to the non-R&D activities of researchers:

> [Commissions] may cause salespeople to slight other activities that are valuable to the firm. For example, if the sales force is a potentially important source of information about customers and competitors, paying commissions may cause them to focus excessively on sales and to ignore information gathering. One logical possibility is to reward information acquisition as well. . . . Performance in information gathering may be exceptionally hard to measure, however . . . . The solution instead may be to reduce or eliminate the sales commission, relying more on straight salary, so that the salespeople's allocation of their time is more in line with the firm's interests.[85]

R&D managers have reached the same solution. This more than anything else explains why researchers are compensated primarily through salary.

The more normative aspects of the job design literature suggest that under some circumstances, however, managers can separate tasks so as to increase the opportunities for incentives to work. In an important paper, Holmstrom and Milgrom[86] describe the importance of measurability and employee incentives in jobs where employees (agents) are expected to perform multiple tasks. They present a model showing that separating tasks according to their measurable characteristics allows the principal to give stronger incentives for tasks that are easy to

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83. MILGROM & ROBERTS, *supra* note 46, at 394.

84. *See id.* at 397; Bengt Holmstrom & Paul Milgrom, *The Firm as an Incentive System*, 84 AM. ECON. REV. 972 (1994) [hereinafter Holmstrom & Milgrom, *The Firm as an Incentive System*].

85. MILGROM & ROBERTS, *supra* note 46, at 397.

86. *See* Bengt Holmstrom & Paul Milgrom, *Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design*, J.L. ECON. & ORG., Special Issue 1991, at 24 [hereinafter Holmstrom & Milgrom, *Multitask Principal-Agent Analyses*].

measure, without fearing that the agent will substitute efforts away from harder-to-measure tasks. There are gains, in other words, from job designs that group hard-to-measure tasks into individual jobs. This thesis finds support in recent empirical work.[87]

This research would suggest that R&D personnel should be separated from other employees, i.e., a high degree of specialization in R&D. This separation does not make it any easier to monitor R&D activities or to measure R&D productivity, both notoriously difficult (and perhaps counterproductive) managerial tasks.[88] But separation does split off the other, non-R&D functions, many of which are presumably easier to monitor. And, with specialized R&D personnel concentrated into individual jobs, it has made sense for firms to invest in refining measures of R&D productivity.[89]

Separating R&D personnel from other employees was the historical trend from the advent of large-scale corporate R&D in the early twentieth century until quite recently.[90] Researchers were typically concentrated in centralized labs that served an entire multi-divisional corporation. However, current thinking has changed course. It is now widely believed that R&D personnel ought to be more integrated into other functions of the firm.[91] Consequently, many firms have

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87. *See id.* at 28 (interpreting empirical studies); Trond Petersen, *Reward Systems and the Distribution of Wages*, J.L. ECON. & ORG., Special Issue 1991, at 130.

88. *See* Alfred H. Schainblatt, *How Companies Measure the Productivity of Engineers and Scientists*, RES. MGMT., May 1982, at 10, 10 (finding that only seven out of 34 companies surveyed attempted to measure R&D productivity); *see also* EDWARD P. LAZEAR, PERSONNEL ECONOMICS 123 (1995) (emphasizing importance of decentralized research unit, with plenty of discretion for individual researchers); Chester, *supra* note 69, at 16.

89. *See* Chester, *supra* note 69, at 16.

90. *See* DAVID A. HOUNSHELL & JOHN KENLY SMITH, JR., SCIENCE AND CORPORATE STRATEGY: DUPONT R&D, 1902–1980, at 56–57, 75, 595–96 (1988); LEONARD S. REICH, THE MAKING OF AMERICAN INDUSTRIAL RESEARCH: SCIENCE AND BUSINESS AT GE AND BELL, 1876–1926, at 67–71 (1985).

91. *See, e.g.*, Rudy K. Moenaert et al., *R&D/Marketing Communication During the Fuzzy Front-End*, 42 IEEE TRANSACTIONS ON ENG'G MGMT. 243, 243 (1995) ("The integration of R&D and marketing activities is a necessary condition for success in innovation projects."); *Stimulating Creativity and Innovation*, RES.-TECH. MGMT., Mar.–Apr. 1997, at 57, 57 ("[T]eam-based structures may be used with concurrent engineering systems, in which R&D, production and marketing staffs work together on developing new products.").

> In today's environment, technical leadership is a source of advantage only if technical and business strategies are well integrated. This integration requires more intense communication and understanding between central research and the business units than had previously existed.
>
> . . . .
>
> . . . Business units tell us that [the] "consulting" services [of Hughes Research Lab, the research arm of the $14 billion GM

reorganized drastically to move R&D out of the ivory tower and into direct contact with operational divisions of the firm, such as manufacturing and marketing. Likewise, at least a portion of central lab R&D funding now comes not from general corporate funds, but from individual business units or divisions of the firm.[92] It is widely believed that greater integration makes R&D more responsive to business goals.[93] But R&D managers have discovered that adding this intra-firm client-contact dimension to researchers' jobs makes it even more difficult to evaluate performance, just as the job design literature suggests. In such an environment, R&D employees have two tasks: traditional R&D, and interfacing with the manufacturing and marketing teams.

More highly integrated R&D thus implies a large number of R&D agents directed to carry out multiple tasks by management. The logic of the multi-task agency literature carries a clear lesson: if one of these tasks pays better than the other, that task will get an inordinate amount of the employees' attention.[94] The practical literature in this field shows that R&D managers are acutely aware of both this effect and its corresponding detrimental effect on teamwork.[95] One experienced R&D

> Hughes Electronics company] are just as important to them as inventing improved or new products and processes. Therefore, incentives must reinforce both types of central laboratory role.

Chester, *supra* note 69, at 17; *see also* Bosomworth & Sage, *supra* note 74, at 38–39 (reporting results of empirical survey: "To transfer technology [from R&D unit to business unit], the most common approach reported was a team of both research and business unit personnel. This method outdistanced the next most popular one by almost 3:1.").

92. *See* Chester, *supra* note 69, at 17–18.

93. *See For Best Results, Decentralize R&D*, BUS. WK., June 28, 1993, at 134.

94. *See* Holmstrom & Milgrom, *Multitask Principal-Agent Analyses*, *supra* note 86, at 25 ("In general, where there are multiple tasks, incentive pay serves not only to allocate risks and to motivate hard work, it also serves to direct the allocation of the agents' attention *among* their various duties."). Aghion and Tirole, *supra* note 56, at 1199 n.19, explicitly recognize the applicability of this literature to the case of R&D employees. That R&D employees with multiple tasks may have conflicting incentives to invest has been understood since the advent of large R&D teams in the early twentieth century. *See* NOBLE, *supra* note 1, at 101.

> It was to the company's advantage to have one strong patent, but it was to the employees' advantage to have a dozen minor patents. . . . It created a situation where men would not work with each other . . . yet the problem which was before them was a problem which required team action; . . . so some way had to be found to get over that.

Id. (alteration in original) (footnote omitted) (quoting statements of Frank Jewett, R&D manager at Bell Labs in 1920s and 1930s).

95. *See, e.g.*, Phillips, *What Is an Inventor's Fair Share?*, *supra* note 74, at 163 (arguing against granting "hefty monetary award" to employed inventors for each invention). "The company also wouldn't want its engineers vying to be first, or at least the first to take credit. What would this do to teamwork? As Ray Ross, president of Cincinnati Milacron, says, 'It's amazing what teams can accomplish if no one cares who

manager puts it this way: R&D "employees will devote a disproportionate amount of their effort to maximizing anything that is visibly, concretely and quantitatively measured."[96] Or, as an empirical study of R&D incentive systems concludes: "One truth seems to be demonstrated: *You get what you ask for.* Reward people for new product ideas and you will get more new product ideas. Reward people for patents and you will get more patents."[97]

If employee-inventors own their inventions, they will devote most of their attention to individual invention. Not only will team-oriented R&D suffer, but the marketing and product manufacturing interface tasks required of the newer corporate R&D model will suffer as well. Plans to better integrate the R&D function into overall operations will also suffer. In this environment, traditional default rules in favor of employer ownership and full enforceability of pre-invention assignment agreements make more sense than ever.

D. Simple Risk Analysis

One might wonder why, if the rules are so unfair, inventive employees continue to seek and obtain jobs inside the R&D units of established firms. The answers are clear: R&D is highly uncertain and R&D jobs in established firms are far less risky than those in technology-based startups. Only when an employee happens to invent a successful technology will the charge of unfairness arise. To take one of many examples, consider the inventor of the very highly successful anti-depressant drugs Valium and Librium. According to trade press reports, he was awarded a total of "several hundred thousand dollars" under the internal reward program of his employer, Hoffman-LaRoche.[98] But these are both multi-*billion* dollar drugs for the firm. As a consequence, the inventor's direct reward "comes to hundredths of a percent" of the amount those drugs earned for the employer firm.[99] This is precisely the scenario often deplored by the critics of current legal rules regarding employee inventions.[100]

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receives credit.'" *Id.* For theoretical treatment of this issue, see Bengt Holmstrom, *Moral Hazard in Teams*, 13 BELL J. ECON. 324 (1982).

96. Chester, *supra* note 69, at 14.

97. Bosomworth & Sage, *supra* note 74, at 40. A related point is made in the context of the economics of property rights. *See* Raghuram G. Rajan & Luigi Zingales, *Power in a Theory of the Firm*, 113 Q.J. ECON. 387 (1998) (arguing that awarding property rights has drawbacks since prospective rightsholders will adapt products for general, rather than specific, use, contrary to what specific trading partners might want).

98. *Employed Inventors Want Part of the Payoff*, CHEMICAL WK., Mar. 24, 1982, at 50, 54.

99. *Id.*

100. *See* Parker, *supra* note 28, at 605.

Obviously, the charge of unfairness in cases such as this fails to take into account several factors. First, the firm's pre-existing investments may have been essential to the creation of the invention. Certainly this is true where the firm was responsible for bringing together a diverse team of inventors. Second, corporate R&D personnel generally receive their salary whether or not a particular line of research pans out. They do not give back their salary when an experiment goes awry or a product design proves unworkable. It might be said, therefore, that by taking a salary, R&D personnel are revealing a preference for relatively low-risk rewards. Indeed, there is a name for inventors who do not mind more risk: entrepreneurs. High risk and high-powered incentives come with ownership of a firm. It is perfectly reasonable for an employee to accept salary in lieu of an entrepreneur's stake in a startup venture. But it is unreasonable to eschew the risk yet claim ownership of those inventions made during employment that later turn out to be successful. If this option were available, employees would claim ownership of valuable inventions, leaving the firm with worthless ones, and corporate R&D would grind to a halt.

E. Case Study

The economic literature described in this Article stresses the benefits of common ownership of complementary assets. Real-world R&D shows the importance of this theme: the case law is replete with examples of complementary employee inventions. For example, in *Paley v. Du Pont Rayon Co.*,[101] patent ownership was awarded to the employer, whose input led to the refinement of the invention.[102] Other cases support employer patent ownership under similar circumstances.[103]

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101. 71 F.2d 856 (7th Cir. 1934).

102. The *Paley* case concerns invention in a well-studied setting. In a famous in-depth study, Samuel Hollander concluded that the bulk of DuPont's process innovations and cost savings in its rayon plants came with the accumulation of unpatentable know-how — precisely the complementary input noted by the court in awarding patent ownership to DuPont. *See* SAMUEL HOLLANDER, THE SOURCES OF INCREASED EFFICIENCY: A STUDY OF DUPONT RAYON PLANTS (1965).

103. *See, e.g.*, Standard Plunger Elevator Co. v. Stokes, 212 F. 893 (2d Cir. 1914) (upholding assignment for previously invented valve and starter plug, and for improvements related to method of plunger elevator control, but not for patent related to drilling holes in ground for oil wells, artisan wells, and wells for plunger elevators); Mississippi Glass Co. v. Franzen, 143 F. 501 (3d Cir. 1906) (finding that defendant conceived wire glass invention during employment, given that defendant had no previous experience with wire glass); United States Colloid Mill Corp. v. Myers, 6 F. Supp. 283 (S.D.N.Y. 1934) (holding that contract requiring employee to assign any inventions pertaining to disbursing agents, or means for obtaining colloidal substances, covered chemical invention for producing colloidal substances, but did not cover mechanical inventions used in process); Georgia-Pacific Corp. v. Lieberam, No. 1:89-CV-0801, 1990 U.S. Dist. LEXIS 19918

By the same token, many cases finding for the employee stress the non-complementarity between the employee's invention and the operations of the employer.[104] The best way to give a flavor of the corporate research environment, however, is by a case study, drawn from *Cubic Corp. v. Marty*.[105]

Cubic Corporation was a San Diego area defense contracting firm that sold a ground-based electronic flight trainer for pilots, the Air Combat Maneuvering Range ("ACMR"). In December 1976, Cubic hired William B. Marty, Jr. as an electronics engineer to work on the ACMR project. In May 1977, Marty came up with an idea: an electronic warfare simulator ("EWS"), a device for training pilots in electronic warfare. Marty's EWS was an electronic system placed on board combat training planes. It was designed to mimic hostile attacks by simulating electronic warnings for incoming enemy aircraft, ground-based missiles, and the like. It replaced Cubic's ground-based system, which involved the use of very expensive, security-risky, mimic radars.

When he started work at Cubic, Marty agreed:

> To promptly disclose to Company [Cubic] all ideas, processes, inventions, improvements, developments and discoveries coming within the scope of Company's business or related to Company's products or to any research, design[,] experimental or production work carried on by Company, or to any problems specifically assigned to Employee, conceived alone or with others during this employment, and whether or not conceived during regular working hours. All such ideas, processes, trademarks, inventions, improvements, developments and discoveries shall be the sole and exclusive property of Company, and Employee assigns and hereby agrees to assign his entire right, title and interest in and to the same to Company.[106]

(N.D. Ga. June 1, 1990) (holding that employee invention relating to condenser system in employer's resins manufacturing plant, and created through consultation with employer personnel and tested by $60,000 prototype built by employer, was property of employer).

104. *See, e.g.*, White Heat Prods. Co. v. Thomas, 109 A. 685 (Pa. 1920) (holding that contract requiring employee to assign inventions related to bricks, stone products, or earthenware products did not require assignment of abrasive wheel, since neither party at time of contract had in mind this possibility and employer's plant was not equipped to manufacture such device).

105. 229 Cal. Rptr. 828 (Ct. App. 1986).

106. *Id.* at 830 (internal quotations omitted).

The agreement also provided that Marty would cooperate in obtaining a patent on any such inventions and that he would not disclose any of Cubic's trade secrets. Under the agreement, Cubic promised to pay all expenses in connection with obtaining a patent, pay Marty a $75 cash bonus upon his execution of any patent application, and pay an additional $75 if a patent were issued.[107]

Marty presented his EWS concept to Minton Cronkhite, his superior at Cubic, since this potentially was a new product that Cubic could add to the ACMR. Cubic previously had plans to add electronic warfare training to its ACMR but the company had not yet developed them at the time of Marty's invention. Cronkhite considered Marty's invention a good idea and presented the concept to another Cubic employee involved with the ACMR, Hubert Kohnen. Kohnen agreed that the idea was good. He assumed it was another product for the ACMR since Marty had suggested that his invention responded to some of the things that Kohnen had been discussing as desirable enhancements to the ACMR.[108]

Cubic funded an internal project to study Marty's invention. Marty used a Cubic computer programmer to help design the necessary circuitry, as Marty's background in microprocessors was "weak." Based on the development of Marty's invention, Cubic submitted a proposal to the Navy under Kohnen's name. Kohnen told Marty that if Cubic got a program from the Navy, Marty would be made the program manager. Cubic did get a government program to study Marty's invention and Marty was made program manager. Marty was also given a substantial raise, more than average for his position.[109]

In June 1978, Marty, without telling Cubic, applied for a patent on his invention. The patent was issued in December 1979. Marty's patent attorney forwarded a copy of the patent to Cubic and offered to discuss giving Cubic a license under the patent. Cubic argued that the patent belonged to them under the agreement Marty had signed. Cubic offered to reimburse Marty for his expenses in obtaining the patent if he assigned the patent to Cubic. Marty refused. Cubic told Marty that his continued employment at Cubic was contingent upon his assigning the patent. Marty continued to refuse and was terminated from his employment at Cubic in early 1980.[110]

Cubic brought suit in San Diego Superior Court to compel assignment of the patent, and won on summary judgment. Marty appealed. His primary arguments were that the assignment agreement lacked consideration and was therefore unenforceable, and that the

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107. *See id.*
108. *See id.* at 831.
109. *See id.*
110. *See id.*

agreement did not apply to his warfare simulator because he was not an "inventive" employee and thus California Labor Code § 2870[111] precluded pre-assignment of the invention.

The California Court of Appeals affirmed. This decision is not surprising in light of the case law, which overwhelmingly favors employers in such cases. What is interesting in the court's analysis is the emphasis on (1) the complementary assets the firm contributed to the invention and (2) Marty's strategic behavior.

According to the Court of Appeals, Marty's invention was created specifically with Cubic's product in mind:

> [T]he proffered evidence . . . indicated Marty presented the invention to Cubic as something to enhance Cubic's ACMR, [and that] the invention was designed to function with and was dependent upon the ACMR and the patent application stated the "preferred embodiment" of the invention was the ACMR.[112]
>
> Marty presented his invention to Cubic as a new product for Cubic, something which could be added to their ACMR. Marty was made program manager on the government contract to study (and refine the design of) his invention. While Marty may not have been a "design" engineer at Cubic, the scope of his employment did not preclude design work and in fact, Marty perceived it as encompassing design work . . . .[113]

The trial court concluded that the manuscript which Marty wrote describing his concept did not embody the invention since it failed to include the necessary circuitry to make the invention work. This circuitry was developed with the aid of a Cubic employee on Cubic time under a Cubic funded program.[114]

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111. *See supra* notes 30–32 and accompanying text.

112. *Cubic*, 229 Cal. Rptr. at 832.

113. *Id.* at 833. The court added, however, that "there was evidence suggesting Marty's invention did not necessarily have to be tied to Cubic's ACMR" but that it *was* closely "related." *Id.* at 832.

114. *See id.* at 836. Marty's patent is replete with detailed electronics schematics which reflect the contributions of Cubic employees. *See* William B. Marty, Jr., *Cockpit Display Simulator for Electronic Countermeasure Training*, U.S. Patent No. 4,176,468 figs.6–8 (Dec. 4, 1979). Moreover, Marty's patent specification refers specifically to Cubic technology, stating, "The detector . . . comprises a diplexer and receiver circuit similar to the circuit used in the airborne instrumentation subsystem (A.I.S.) pod and a mark/space detector Model #145790 manufactured by Cubic corporation." *Id.* col.6,

The importance of complementarity in the decision of this case is consistent with the holdup analysis presented earlier.[115] Cubic would have known that its microprocessor know-how would be especially valuable in combination with employee inventions. Thus, if inventions were owned by the employees, and not the firm, the firm would have to split with the employee any surplus created by the combination of firm know-how and employee invention. If Cubic knew that it was going to have to split the proceeds of its investment in microprocessors with an employee such as Marty, it might have invested less, or even refrained from making these investments in the first place. And of course the next employee, call him A, would know that the surplus from any investment *he* made (in time, training, foregone opportunities, etc.) in improving Marty's warfare simulation unit would have to be split three ways: between Marty, the firm, and himself. The next employee after A, call her B, would similarly know that improvements to A's improvements would be subject to a four-way split. And so on.

Indeed, this is more than a hypothetical. Marty's co-worker Minton Cronkhite did subsequently invent an improvement on Marty's device.[116] Cronkhite's invention was also assigned to Cubic, though this time without the need for court intervention. The lesson is clear, however: if Marty had owned his patent outright, Cronkhite's invention would have been more difficult to commercialize. Knowing this, Cubic might not have invested in Cronkhite's research, and the improvement might never have been made at all.

Equally important to the court was the notion that Marty's opportunistic behavior ought not to be rewarded.[117] "[W]e do not think," said the court, "[that] the [law was] intended to award an invention to an employee who presents an invention to an employer, represents [that] the invention is for the employer's benefit, actively seeks and obtains company funding to refine his invention, [and] uses company time and funding to develop his invention while all the time secretly intending to take out a patent on the invention for himself."[118]

This is entirely in keeping with the literature on employee incentives reviewed above.[119] The court was concerned that employees who decide how to allocate their time and effort with an eye toward invention

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ll.22–26.

115. *See supra* Part IV.A.

116. *See* Minton B. Cronkhite & Daniel N. Kamhis, *Method of Generating a Dynamic Display of an Aircraft from the Viewpoint of a Pseudo Chase Aircraft*, U.S. Patent No. 5,308,022 (May 3, 1994) (citing Marty patent).

117. This is by no means unique to the *Cubic* case. *See, e.g.*, Mississippi Glass Co. v. Franzen, 143 F. 501 (3d Cir. 1906) (assigning to employer invention for which employee went to great lengths to conceal his experiments).

118. *Cubic*, 229 Cal. Rptr. at 836.

119. *See supra* Part IV.C.

ownership will end up being counterproductive members of the firm's workforce. Thus, the court highlighted that Marty applied for his patent "without telling Cubic."[120] Awarding ownership to Cubic, the employer, makes it less likely that the next employee will do something similar.

F. Default Rules for Consultants and the Like

The case law has begun to catch up with the changing nature of the employment relationship. Increasingly, courts apply the default rules forged in the era of large, vertically integrated R&D to the more diverse circumstances of modern day research, where discrete, specialized R&D projects are increasingly common.[121] For the most part, courts hold that non-employees own their inventions outright unless a contract specifies otherwise.[122] In addition, courts tend to construe consultant assignment obligations narrowly, in favor of consultants, which stands in stark contrast to the pro-employer construction of most employee assignment contracts.

In general this dichotomy makes sense because it reflects the choice of the researcher to forego full employee status. Favoring consultants is a beneficial rule for two more reasons. First, it encourages segregation of inventors into two classes: those where the transaction costs of integrating inventive work are expected to be high, and those where these costs are low, or at least justified by the need for the high-powered incentives that come with independent invention and ownership. The former class implies an employee relationship. The difference in default ownership rules between classes has obvious benefits. Unless there is a substantial threat of holdup, individual ownership of property rights is superior. Thus, allowing consultants, independent contractors, and other external R&D providers to retain their property rights (at least at the outset) makes good sense. It gives them the best incentive to perform.

The second reason to permit consultants to retain ownership of inventions is that it serves as a penalty default.[123] The notion here is that

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120. *Cubic*, 229 Cal. Rptr. at 831.

121. *See, e.g.*, McElmurry v. Arkansas Power & Light Co., 995 F.2d 1576 (Fed. Cir. 1993) (applying shop right doctrine to consultant); *cf.* Bailey v. Chattem, Inc., 684 F.2d 386 (6th Cir. 1982) (holding that process was invented before inventor entered into consulting agreement with employer that required inventor to assign to employer all inventions made during his consultation).

122. *See* Lone Star Steel Co. v. Wahl, 636 S.W.2d 217 (Tex. App. 1982) (holding that employer manufacturing company did not acquire shop right in improved pipe designs, when, during contract negotiations between parties, issue of patent rights was specifically discussed but stricken from draft of contract upon refusal of consultant to agree to it, and when consultant expressed determination to retain patent rights).

123. *See* Ayres & Gertner, *supra* note 62, at 87–99.

since employers are in a better position to know whether a consultant's planned R&D is likely to produce inventions highly complementary to the firm's pre-existing assets, the burden ought to be on the employer to disclose this information to the consultant ex ante.[124] Armed with information about whether the employer wants to own his inventive output, the consultant is in a better position to negotiate his compensation and protect his rights.

Greater clarity of property rights, and in some cases more robust rights as well, have contributed to the increase in organizational diversity that characterizes today's economy.[125] Increased reliance on consultants is one example. Subsequent empirical work has backed the claim that stronger property rights, especially patents, enables more transactions and thus correlates with organizational diversity.[126] Property rights give an economic actor a legal claim over the embodiment of his labor, which makes it more difficult for another party to appropriate the actor's work product.[127] By lowering the chance of opportunism, property rights lower transaction costs. The law ought to recognize and encourage this trend by maintaining the de facto default rule in favor of consultant ownership of inventions.

V. A More Complete Picture of Invention-Related Compensation

Ownership is too blunt an instrument to be an effective inducement to employee-inventors. This does not mean that employees have no bargaining power vis-à-vis employers, however; nor is ex post ownership the only way to create employee incentives ex ante. This Part discusses two features of inventive employment that tend to increase employee compensation for specific inventions: (1) employee reward

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124. *See* Darryl Mischlewski, *Inventions Pay the Price*, Managing Intell. Prop., Oct. 1994, at 4.

125. *See* Robert P. Merges, *Intellectual Property and the Costs of Commercial Exchange: A Review Essay*, 93 Mich. L. Rev. 1570, 1591 (1995) (book review); Robert P. Merges, Intellectual Property Rights, Input Markets, and the Value of Intangible Assets 34–35 (Feb. 9, 1999) (unpublished manuscript), *available at* <http://www.sims.berkeley.edu/BCLT/pubs/merges/>.

126. *See* Bharat Anand & Tarun Khanna, Intellectual Property Rights and Contract Structure 7–11 (Harvard Bus. Sch. Working Paper No. 97-016, 1997).

127. This is a straightforward extension of the observation that patents solve the "information paradox" by permitting full disclosure of an idea without the risk that the idea, once revealed, will be free to steal. *See* Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* The Rate and Direction of Inventive Activity: Economic and Social Factors 609, 616–17 (National Bureau of Econ. Research ed., 1962).

plans, and (2) the "exit option," i.e., the possibility that employees may exit a firm with the germ of a particular invention.

A. Employee Reward Plans

The history of intra-firm R&D management is a history of experimentation to find the right set of incentives. This history and the contemporary reward systems it spawned disclose an important lesson. Firms have sought to mitigate the dampened employee incentives that flow from firm ownership of inventions through a wide variety of reward systems, ranging from the ad hoc to the highly formal. From one-time cash payments, to implicit contracts concerning promotions and privileges, to bonus systems based on simple output measures (e.g., $500 per patent), to elaborate review boards and team-oriented profit sharing schemes, firms have developed a host of employee reward mechanisms that do not require employee ownership of inventions. These reward systems form a special part of the firm's internal labor market: they create an "intra-firm appropriability environment," which sets the conditions under which employees reap (or appropriate) returns from their inventive efforts. Reward plans represent a special application of the general concept of the "firm as an incentive system."[128]

For the critics of employee invention law, and for advocates of European-style invention reward legislation, intra-firm reward systems pose a challenge. They reward employees with compensation calibrated in many cases to the perceived merit of the inventive employee's contribution, and they do so without a government-run review board. Indeed, the sheer variety of these reward plans attests to a degree of flexibility that would be difficult to build into a government-run scheme. In this respect, intra-firm reward systems share many features of other intellectual property valuation mechanisms. Because they are administered solely within private businesses, however, they are examples of what might be called "private intellectual property systems."[129] Moreover, in recent years the absolute dollar value of rewards has increased in many firms. While not a complete answer to the critics, who note the often small absolute dollar rewards granted by firms, this trend at least suggests that the traditional account of one-sided (pro-employer) bargaining over employee invention rewards does not tell the entire story.[130]

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128. *See* Holmstrom & Milgrom, *The Firm as an Incentive System*, *supra* note 84.

129. *See* Merges, *Contracting into Liability Rules*, *supra* note 10, at 1361–62.

130. This is not to underestimate the significance of bargaining power when it is present, *see, e.g.*, Aghion & Tirole, *supra* note 56, at 1189–90, 1192–94, but rather to caution against inferring its presence too readily. For a recent study concluding that bargaining power — and not the efficient, incentive-oriented allocation of residual

Because there is such variety in intra-firm reward systems, it is difficult to summarize them concisely. In general, however, reward systems can be grouped into four rough categories that represent points along the spectrum: (1) implicit career-path progressions that reward significant inventions through a series of implicit promotions;[131] (2) spot

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rights — explains much about the allocation of control rights in biotechnology strategic partnerships, see Lerner & Merges, *supra* note 59. As this Article demonstrates, the exit option gives employees more bargaining power than many commentators realize. *See infra* Part V.B. Even when employers have significant bargaining power, however, this is no indication — standing alone — that the resulting allocation of ownership rights is inefficient. Finally, courts *will* rescind deals brought about through gross abuses of bargaining power. Examples discussed in this Article include (1) unreasonable noncompetition clauses, *see supra* note 21, (2) unreasonably long post-employment assignment clauses, *see infra* Part V.B.2, and (3) employee assignments procured through fraud, *see supra* note 29.

131. The inventor in the *Cubic* case, Marty, is an example. *See supra* Part IV.E. For another example, see Robert D. Davila, *Inventor Makes Hall of Fame: UC Davis Professor Honored for Creating Semiconductor Device*, SACRAMENTO BEE, June 16, 1997, at B1.

> For himself, [Robert] Bower [inventor of the metal oxide semiconductor-field effect transistor, or MOSFET, a major semiconductor advance] never made a fortune on his discoveries for several high-tech firms — which, like most U.S. companies, hold the licensing rights to employees' inventions. But Hughes [Research Lab] promoted him quickly, gave him a staff and invested millions of dollars to develop his semiconductor device.
>
> "They had enough faith in me to make it happen — that was my reward," Bower said. "To come up with an idea and then turn it into reality is an inventor's dream."

Id. at B3.

Note that a firm which frequently reneges on an implicit career-path incentive scheme, by failing to promote hard-working employees, will obtain a bad reputation among employees and prospective employees. Knowing this, management will normally refrain from reneging. *See* MILGROM & ROBERTS, *supra* note 46, at 379; *see also* Shari Caudron, *Motivating Creative Employees Calls for New Strategies*, PERSONNEL J., May 1, 1994, at 103.

> A recent survey conducted by *Training and Development Magazine* revealed that effective dual career paths are those that consistently reward technical workers with status, salaries and incentives that compare favorably with those enjoyed by managers. Furthermore, technical-career-path systems thrive in organizations that are committed to helping technical people assess their interests, preferences and strengths so that they can make informed career choices.
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> Microsoft in Redland [sic], Washington, is among the many large research-dependent organizations that have implemented technical career paths. As Tom Corbett, a developer with 10 years' experience at Microsoft, explains, "There's never been any motivation for me to go into management because of better compensation or more influence."

Id. at 106.

bonuses given for significant inventions;[132] (3) output-based bonus schemes; and (4) more elaborate reward systems based on an administrative assessment of invention value, individual employee contribution, etc.[133]

These plans seem to exhibit a trend toward more significant rewards for the inventor.[134] For example, one recent survey states:

> At Dallas-based Texas Instruments, an inventor can receive up to $175,000 in bonuses for a single patent, although these large awards are extremely rare. Monsanto Corporate Research in St. Louis awards employees $50,000 for significant "lifetime" achievements. And IBM gives Outstanding Innovation Awards for important inventions or scientific discoveries. Ranging from $2,500 to $25,000, about 40 of these awards are given each year.
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> . . . .
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> BMC Software in Sugar Land, Texas, has found its royalty compensation plan so successful in incenting [sic] product development that it won't even talk about the program publicly anymore. Two years ago, the firm stated in its annual report that it had paid $4.9 million in royalty compensation and that some individual programmers were earning more than $1 million per year because the products they developed were so profitable. "We view compensation as an important part of our success," explained a company spokesperson, "but we'd rather not do interviews on this subject. It's very sensitive." Put another way, BMC's royalty plan has become a competitive trade secret.[135]

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132. *See* Caudron, *supra* note 131, at 105; Kathleen Murray, *HR Takes Steps to Protect Trade Secrets*, PERSONNEL J., June 1, 1994, at 98.

133. Although such project-based schemes are still rare (one survey estimates that only 7% of U.S. companies use them, *see* Caudron, *supra* note 131, at 104), they appear to be gaining in popularity among firms, *see id.* at 104–05; Chester, *supra* note 69, at 18–20. Some firms, however, have long followed a practice of differential compensation for inventors. *See Employed Inventors Want Part of the Payoff*, *supra* note 98, at 54 (describing Hoffman-La Roche plan, which paid "several hundred thousand dollars" to Leo H. Sternbach, inventor of Valium and Librium).

134. *See* Lynn W. Ellis & Sandra Honig-Haftel, *Reward Strategies for R&D*, RES.-TECH. MGMT., Mar.–Apr. 1992, at 16.

135. Caudron, *supra* note 131, at 105.

Another article by two economists points to performance pay for scientists and engineers as a good example of the growing popularity of individual incentive pay:

> Pay-for-performance schemes also have been used with scientific and engineering personnel. For example, Applied Materials Inc., a $500 million California-based producer of equipment for manufacturing semiconductors, gives employees who develop successful new products a percentage of the resulting sales revenues. Under this plan, the physicist who led the team that developed one especially successful product received more than $800,000 in 1989 in incentive pay. He thus ended up earning considerably more than the corporation's chief executive officer. Such plans directly reward and encourage creativity and innovation, and they also help motivate researchers to be concerned with the ease with which their products can be manufactured and sold. They are especially attractive in the high-tech industries of California's Silicon Valley because they help hold engineers and scientists who otherwise would be lured away to new, start-up, [sic] firms, where they can have more independence and a significant ownership stake.[136]

While it may come as no surprise to economists, personnel experts are rapidly discovering that larger rewards produce better results.[137] Reward plans, together with the high volume and visibility of spinoffs alluded to in the preceding quotation, at the least motivate firms to experiment with more elaborate reward programs, to the benefit of employed inventors.

1. Judicial Enforcement of Intra-Firm Reward Programs

Credibility is a serious problem with intra-firm reward programs. One empirical survey[138] of 879 idea submissions made to members of the National Association of Suggestion Systems concludes that suggestion box systems do elicit extra ideas from employees, but that

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136. MILGROM & ROBERTS, *supra* note 46, at 399–400 (footnote omitted).

137. *See* Ellis & Honig-Haftel, *supra* note 134, at 19.

138. *See* Barry Weinmann & Brian D. Wright, Markets in Hierarchies: Employee Suggestion Systems and the Theory of Labor Contracts (Dec. 1996) (unpublished manuscript, on file with the *Harvard Journal of Law & Technology*).

compensation for ideas falls below the level that might be expected.[139] Nevertheless, these plans have at least some credibility: courts routinely enforce express and implied promises of compensation for employee inventions,[140] although they are loath to micromanage plans that give employers discretion.[141] In addition, courts are sometimes open to claims for unjust enrichment arising out of employee inventions and contributions.[142]

The firms themselves ought to be grateful for vigorous judicial enforcement of reward plans, of course. External enforcement makes the promised rewards much more credible. Judicial enforcement has significant limits, however. Given the firm-specific nature of the plans and the costs of explaining to judges firm operations, specific inventions, and plan administration, such external enforcement cannot be expected to tailor awards as well as an honest firm reward plan. Nevertheless, the threat of judicial oversight at least prevents egregious opportunism on the part of firms.

2. Contrast with Government-Operated Review Boards

In many countries, employee compensation for at least some inventions is mandated by law.[143] In Germany, for example, the German Employee Inventions Act of 1957 requires that the employer separately

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139. *See id.* at 27.

140. *See, e.g.*, Lone Star Steel Co. v. Scott, 759 S.W.2d 144, 152 (Tex. App. 1988) (upholding jury award of over $3 million: "Although Lone Star's basic suggestion plan is couched in purely optional or discretionary terms, there is sufficient evidence that later modifications of the plan in the form of [company] newspaper announcements and agreements by Lone Star's officers constituted an agreement to pay some award if an idea was actually adopted and used.").

141. This would appear to be a good policy, given the complexity, variation, and firm-specific features of these plans. As one consultant puts it:

> "The reason [royalty compensation programs] are not more widely used is that there are a lot of other issues [these programs] get saddled with," [John McMillan, human resource consultant,] says. Among the questions employers must answer are: What are we trying to incent? [sic] What percentage of profits should be returned to employees? How do we determine who's eligible? And what kind of message will this send to employees who don't receive royalties? Yet, McMillan says, "the advantages far outweigh the disadvantages."

Caudron, *supra* note 131, at 105 (second alteration in original).

142. *See, e.g.*, Kopin v. Orange Prods., Inc., 688 A.2d 130 (N.J. Super. Ct. App. Div. 1997) (denying firm's motion for summary judgment on ex-employee's claim for breach of implied contract and unjust enrichment through use of ex-employee's suggestions regarding ways to improve firm's grinding wheels).

143. *See* Ruete, *supra* note 45, at 180.

compensate each employee who invents in the course of employment.[144] Complex regulations promulgated by the Ministry of Labor specify how the employee's contribution to the invention is to be evaluated. The general approach is to pay each employee-inventor as if he held ownership rights and had entered into an arm's length licensing agreement with the employer.[145] Employees dissatisfied with the employer's offer of remuneration under the regulations can either submit to voluntary arbitration by a panel of experts or go to court. Employee rights in Germany are liability rules in the lexicon of entitlements theory:[146] employees are entitled to compensation, but cannot seek an injunction.

In practice, the German system has many detractors. A recent survey of R&D personnel revealed that "the general consensus in industry is unfavourable to the German Act."[147] Survey respondents cited the complexity of the compensation guidelines and deleterious effects on teamwork as two of the primary problems with the Act. The survey concluded:

> [T]he administrative effort and the cost of calculating and controlling the compensation [under the German Act] is rather high. In the central patent department of Siemens AG, Germany, for example, up to 10% of the entire working hours of the patent attorneys is spent managing compensation problems. The consequences . . . are the encouragement of secrecy through a negative impact on the communication flow among R&D professionals. This can be extremely unfavorable for the quality of team work within R&D units.
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> . . . [The Act] leaves team members from other functional areas like production and marketing who are supportive to the success of the innovation but who are not inventors without an award. . . . Furthermore, the compensation guidelines are individually oriented and not appropriate for use as a team compensation instrument. Thus, a significant problem arises from the lack of communication and exchange of experiences, as inventors try to make new inventions

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144. *See id.*

145. *See* Christopher Leptien, *Incentives for Employed Inventors: An Empirical Analysis with Special Emphasis on the German Law for Employees' Inventions*, 25 R&D MGMT. 213, 214–15 (1995); *see also* Ruete, *supra* note 45, at 194.

146. *See* Calabresi & Melamed, *supra* note 47, at 1106.

147. Leptien, *supra* note 145, at 213.

> on their own to earn a higher share in the compensation.[148]

Few German employees dispute their invention awards under this system; those that do typically are ex-employees seeking compensation for an invention made prior to leaving the firm. This is, to be fair, partly due to the cumbersome and complex procedure for determining each inventor's compensation mandated under German law.[149] It is clear to all parties that there would be very high "influence costs" in educating and persuading an independent tribunal regarding the merits of the invention and the process through which it was created.[150] Since the burden is on the employee to demonstrate that the employer's offer of compensation is inadequate, most employees may simply deem it a losing proposition to try to challenge the offered award.[151] Another explanation for the infrequency of challenges is that employees who wish to make a career in a particular company are loath to challenge corporate policies in court; the long-term career harm may not be worth the gain from a single invention.

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148. *Id.* at 223–24.

149. *See, e.g.*, Ruete, *supra* note 45, at 198–201. Under the German system, a "participation factor" quantifies an employee's claim to an invention. Three criteria are used to determine the participation factor: (1) statement of the problem, (2) solution of the problem, and (3) duties and position of the employee in the company. *See id.* at 199–200.

> The total amount of remuneration and the share in the invention do not necessarily give a clear picture of the remuneration payable to each inventor. This is due to the fairly complicated methods of establishing the inventor's remuneration for an invention. For example, the total sum of the remuneration may amount to 1000 Deutschmarks and the co-inventors' share in the invention may be 33% each. One inventor may, nevertheless, receive far more than a third of the remuneration, as his claim to remuneration may be considered to be greater than that of his two co-inventors. This may be the case when the third inventor's contribution was based on individual research in a field that had little to do with his normal work as an employee whereas the other two thirds of the invention originated from contributions of the company's research laboratory.

Id. at 198; *see also* Leptien, *supra* note 145, at 217 (empirical survey documenting widespread dissatisfaction with complexity of German compensation system); Erich Staudt et al., *Incentive Systems as an Instrument of Company Innovation Management: Results of an Empirical Investigation in the R&D Sector*, 6 INT'L J. TECH. MGMT. 395, 400–03 (1991) (same).

150. *See* Jeremy Phillips, *Employees' Inventions: An Analysis of the Nature of the Subject, in* EMPLOYEES' INVENTIONS: A COMPARATIVE STUDY, *supra* note 45, at 21.

151. Note, however, that challenges by others will still exert an influence, making it plausible that employees who would not themselves challenge offered compensation will still bias their R&D efforts in a direction that maximizes their compensation under accepted application of the regulations.

For all these reasons, the complex German system is deeply flawed. Compensation plans administered by firms no doubt encounter similar problems, but the decisionmakers under intra-firm reward plans, unlike government bureaucrats, are intimately familiar with the industry, the technology, the firm, and perhaps even the individual inventors. This knowledge, together with the freedom from a cumbersome administrative structure, permits each firm to experiment and adapt its reward plan to produce the optimal incentives. Employees benefit more from this diversity of reward schemes than they would benefit from a "one size fits all" solution, as found in Germany.

B. The Exit Option: Ex-Employees and Startup Firms

The passage about performance pay excerpted earlier stresses that lucrative incentive schemes for researchers are partly the result of pressure from the threat of startup companies.[152] This section discusses (1) how legal rules regarding departing employees help to make the threat credible and (2) how the exit option helps to constrain employer opportunism, thus counterbalancing to some extent pro-employer rules of invention ownership.

It is not at all uncommon for ex-employees to leave a firm and found a new venture — a spinoff — with the firm's blessing. Sometimes a spinoff merely involves permission to leave with no strings attached.[153] In other cases, the employee founds a spinoff with help from the parent firm.[154] Indeed, at least one firm, ThermoElectron, Inc., specializes in generating spinoffs.[155] Help may take the form of technology licensed from the parent firm, or financial assistance, or both.[156] Whatever the form, corporate-backed venture capital funds, while subject to a good deal of ebb and flow, have in general been on the increase since the 1970s, and it is clear that the availability of an exit option is an important factor in the decision to set up such a fund.

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152. *See supra* note 136 and accompanying text.

153. *See* IRA FLATOW, THEY ALL LAUGHED . . . FROM LIGHT BULBS TO LASERS: THE FASCINATING STORIES BEHIND THE GREAT INVENTIONS THAT HAVE CHANGED OUR LIVES 143–46 (1992) (describing W.L. Gore's failed efforts to get his employer, DuPont, to take notice of his discoveries, which he later commercialized on his own as "Gore-Tex"); Laurence Zuckerman, *Tiny Turbine: The Next Generator?: Company Hopes Its Small Unit Will Dominate Power Market*, N.Y. TIMES, Dec. 2, 1997, at D1 (describing small, innovative high-efficiency turbine designed by startup company founded by ex-employees of Allied Signal, Inc.).

154. *See* Carrie Dolan, *Tektronix New-Venture Subsidiary Brings Benefits to Parent, Spinoffs*, WALL ST. J., Sept. 18, 1984, at 33.

155. *See* Norm Alster, *Making the Kids Stand on Their Own*, FORBES, Oct. 9, 1995, at 49.

156. *See* James Brian Quinn et al., *Leveraging Intellect*, ACAD. MGMT. EXECUTIVE, Nov. 1996, at 7, 19–20.

According to a recent account of one venture fund, Xerox Technology Ventures, the committee that set up the fund was given the task of preventing too much uncompensated technology leakage from the firm:

> The committee focused on two options: (1) to begin aggressively litigating those who try to leave with new technologies, and (2) to invest in people trying to leave Xerox. Due to variations in employee non-competition law across states (and particularly the weak level of protection afforded by the California courts), it was unclear how effective a policy of aggressive litigation would be. Furthermore, such a policy might reduce Xerox's ability to recruit the best research personnel, who might not want to limit their future mobility.
>
> Based on the task force's recommendation, [Xerox] Chairman Kearns decided to pursue a corporate venture capital program. He agreed to commit $30 million to invest in promising technologies developed at Xerox.[157]

It should be noted that parent-backed spinoffs make most sense when (1) there is a high degree of complementarity between the concept for the spinoff and the parent firm's technological capabilities, and (2) the concept is in an early stage or the invention involves a high degree of non-codifiable, employee-specific know-how held by the employee. When one or both of these factors applies, the exit option outlined here, and the possibility of an employer-backed spinoff,[158] can be quite valuable to the employee. This suggests once again the weakness of traditional pleas to improve the lot of the employed inventor, which all assume that inventors have no other option besides corporate employment. The full picture of the options an employee-inventor enjoys shows that employees are not nearly as badly off as critics have asserted.

1. Legal Rules Surrounding Startups

While the rules of invention ownership for employees can be summarized as "caveat inventor," those for recently departed employees are in general more favorable — often much more so. With respect to the narrow question of invention ownership (as opposed to the trickier

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157. GOMPERS & LERNER, *supra* note 80, at 13.
158. *See* Anton & Yao, *supra* note 2; *supra* notes 154–56 and accompanying text.

issue of trade secret misappropriation[159]), both the default rules and the interpretation of post-employment contracts favor ex-employees. Ex-employees usually receive the benefit of the doubt when a case presents a close question of timing, i.e., when the employer suspects (but cannot prove) that an ex-employee actually came up with the idea for an invention while still employed. Experienced employee-inventors can be expected to know this. Hence it is in many cases quite feasible to leave a firm after one arrives at the general notion of an invention, but before any of the provable milestones of invention arrive. The law focuses almost exclusively on these milestones, so in many cases an employed inventor has a de facto exit option. Once this is understood, it becomes clear that the inventor often opts into firm ownership as dictated by his employment contract. Put another way, the inventor *chooses* to remain bound by the terms of the agreement by revealing his invention.

The earliest observable milestone in the invention process is the legal event known as "conception." The operative legal rule is that conception is the first occurrence of the complete invention in the mind of the inventor, *as corroborated by objective evidence*.[160] Despite its name, then, conception is not in practice simply a mental event; it requires that the idea be written down or otherwise embodied and that some evidence of the event be kept. This requirement is normally met by having a colleague of the inventor witness the lab notebook pages describing the invention.[161] In some fields, empirical investigation is required before conception (in the sense of full comprehension of the basic features of an invention) is complete;[162] when this holds, conception merges with the next milestone on the path to invention, "reduction to practice."[163] Obviously external manifestations are even

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159. In theory, all inchoate inventions — those in the pre-conception stage — might be claimed as trade secrets by the employer firm. By recasting a dispute as misappropriation of a trade secret (where the trade secret is an unfinished concept), the firm would avoid the pro-employee case law that triggers firm ownership only when conception is complete. Perhaps surprisingly, very few cases grapple with the fine distinction between employee invention and firm trade secret. Those that do, while lacking an enlightening rationale, tend to side with the employee. *See, e.g.*, Wexler v. Greenberg, 160 A.2d 430 (Pa. 1960), *discussed in* ROBERT P. MERGES ET AL., INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE 97–99 (2d ed. 1997). It is worth noting that cases such as *Wexler* prevent employers from using trade secret law to eliminate the exit option otherwise provided by the law of employee inventions.

160. *See, e.g.*, Mahurkar v. C.R. Bard, Inc., 79 F.3d 1572, 1577 (Fed. Cir. 1996).

161. *See, e.g.*, Gould v. Schawlow, 363 F.2d 908 (C.C.P.A. 1966).

162. *See, e.g.*, Amgen, Inc. v. Chugai Pharm. Co., 927 F.2d 1200, 1206 (Fed. Cir. 1991) ("We hold that when an inventor is unable to envision the detailed constitution of a gene so as to distinguish it from other materials, as well as a method for obtaining it, conception has not been achieved until reduction to practice has occurred, i.e., until after the gene has been isolated.").

163. *See* 35 U.S.C. 102(g) (1994); *see also* Scott v. Finney, 34 F.3d 1058 (Fed. Cir. 1994).

more essential to proof of an invention in these fields. Thus in all cases, an inventor must do something affirmative — and hence observable — before an invention can be identified.

Absent any affirmative steps by the inventor, there is *no* proof of an invention. Importantly, such proof is universally required to trigger the operation of pre-invention assignment agreements. Even the most sweeping — and therefore most common — form of pre-invention assignment obligation excludes inventions not yet conceived.[164] This in some sense follows from the logical requirement that an assignment, however inchoate, cannot operate in the absence of something to assign. Although, in theory, trade secret law protects pure information, in practice ex-employers rarely succeed in court when the former employees take nothing tangible with them.[165] True, the research leading up to an invention may yield material potentially protectable as firm trade secrets, such as tangible data, lab notebook entries, and even ideas, but it is a simple matter to leave trade secrets behind and still base a startup company on a concept developed at the old job.

For example, in *Koehring Co. v. E.D. Etnyre & Co.*,[166] an employee signed a fairly typical agreement requiring him to disclose all improvements, discoveries, and inventions related to business carried on or contemplated by his employer firm that he developed during employment. The court, stating that the agreement did not give an employer "a mortgage on all thoughts occurring to the employee"[167] and did not include ideas drawn from the employee's general knowledge,[168] ruled that the employee's rough sketches and designs "were never developed [during employment] to the extent that they constituted material subject to the agreement."[169] The court also held that the employee had not breached any sort of duty by not further refining his design during the term of employment.[170] In another case, the court awarded ownership of a process invention to the inventor, despite evidence that the employer had taken steps to protect its technology as a trade secret.[171] In this and many other cases, close calls go to the ex-

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164. *See, e.g.*, American Tel. & Tel. Co. v. Integrated Network Corp., 972 F.2d 1321 (Fed. Cir. 1992) (implying that even trade secrets not yet technically meeting test of "conception" may belong to ex-employee). For an example of an agreement claiming all inventions conceived during employment, see the agreement in the discussion of the *Cubic* case study, *supra* text accompanying note 106.

165. *See* MERGES ET AL., *supra* note 159, at 82–93.

166. 254 F. Supp. 334 (N.D. Ill. 1966).

167. *Id.* at 362.

168. *See id.*

169. *Id.* at 355.

170. *See id.* at 362.

171. *See* John Mohr & Sons, Inc. v. Jahnke, 198 N.W.2d 363 (Wis. 1972).

employee. The law, in short, tends generally to favor the startup firm, all other things being equal.[172]

The law favors startup firms even when it is apparent that the ex-employee acted strategically in the period leading up to exit. *Jamesbury Corp. v. Worcester Valve Co.*,[173] for example, centered around an invention patented by Howard Freeman very shortly after leaving his former employer. Freeman gave the following description of his exit interview:

> [My supervisor] asked me if I had done any work on my ideas on company time or at company expense. I told him that I definitely had not — that I had reduced nothing to writing, drawings or practice; and that I would have to prove out some ideas by experiments. * * * I also pointed out . . . that I had no specific ideas and that I had to explore many avenues before I even knew what I was going to do.[174]

The district court concluded otherwise. Noting that Freeman was paid through January 30, the court stated:

> Actually, Freeman knew very well what he was going to do. He had definitely decided before his meeting with [his supervisor] on January 13 that he and [a fellow employee] would form a corporation to manufacture double-seated ball valves from hard brass bar stock (as distinguished from individual castings) and that they would have soft lip seats of rubber, nylon, teflon or similar material. At least prior to January 25 and almost certainly before January 20, Freeman . . . engaged Boston counsel to draft the planned company's articles of incorporation and bylaws. . . . Freeman spent the remaining days in January organizing his personal affairs and organizing Jamesbury Corporation. The organizational meeting

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172. *See, e.g.*, *id.* at 404–05 (upholding jury's finding that employee "made" invention after leaving his former employer); Dow Chem. Co. v. American Bromine Co., 177 N.W. 996, 1007 (Mich. 1920) ("[T]he [ex-employee's] patent . . . was, as claimed by him, based upon investigation and invention subsequent to the termination of his employment by plaintiff. It is therefore not subject to the terms of the contract existing between him and the plaintiff during the latter years of his employment," notwithstanding plaintiff's efforts to protect its information as trade secrets).

173. 318 F. Supp. 1 (D. Mass. 1970).

174. *Id.* at 4 (second alteration in original) (internal quotations omitted).

> of the new company, of which Freeman was to be president and principal shareholder, was held January 29. [Jamesbury] was already holding the investors' checks [for stock in the new company] post-dated to February 2.[175]

It was quite apparent, then, that Freeman had planned his exit strategically. But did this mean that the employer owned the invention? No. According to the court:

> In this case Freeman virtually conceived patent '666 while employed . . . as director of research. . . . [Yet] it is impossible to find on the basis of the evidence that Freeman had completely conceived the entire invention at the time he left [the firm]. He had gotten to the point where no more than an additional few days or perhaps few hours of thinking was required for him to put his ideas on paper in a form substantially the same as his later patent application. The other key finding of fact is that Freeman deliberately refrained from reducing his ideas to drawings or written description until after his resignation. Plaintiff's position is that, in his fiduciary capacity as head of the corporate research department, Freeman should have disclosed his ideas to his employer whether or not they amounted to complete conception and that he violated his agreement by not endeavoring to reduce them to writing while still a company employee. Defendant's response is that Freeman's entire duty in the matter was described in the contract and that he was entitled to suspend his inventive process and prescind from the solution of the problems which he recognized while a[n] . . . employee until after resigning.
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> . . . [I]n this case there are circumstances indicating a lack of good faith on the part of Freeman such as his making unreasonable demands which would give him an excuse to resign . . . . On the other hand, an inventor who defers embodiment of his novel ideas runs the risk that another will be the first to make the same invention. In the instant case there were

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175. *Id.*

> other bright engineers at [the firm] . . . who had the same information at their fingertips as did Freeman; and they might well have conceived the same novel ideas while Freeman was holding off putting his ideas on paper. . . . A literal construction of the contract in this case . . . seems consistent with the broad public policy of encouraging inventors to take financial risks for the betterment of society.[176]

Were it not for some recent (and somewhat disturbing) trends in trade secret law,[177] the picture for departing employees would be quite positive indeed. But even taking account of recent extensions, an employee is in general free to leave a firm, develop an inchoate concept, and enjoy full ownership of the resulting invention. Thus, employee mobility continues to be an important policy informing both trade secret law and the law of ex-employee invention ownership.

The policy favoring employee mobility is working. The majority of startup founders report that they arrived at the most important technology for their new venture from previous experiences, such as their prior jobs.[178] And, most importantly, whatever the role of trade secret and employee invention law, the rate of startup activity continues to be impressive.[179]

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176. *Id.* at 7, 9 (footnote omitted).

177. *See* MERGES ET AL., *supra* note 159, at 90–92 (discussing "inevitable disclosure" doctrine).

178. *See* Delaney, *supra* note 69, at 216.

179. Indeed, even trade secret specialists attest to the difficulty of enforcing these legal rights; many argue that the best defense against misappropriation is to maintain a good working environment so employees will not leave. *See, e.g.*, Roger Norman Coe, *Keeping Trade Secrets Secret*, 76 J. PAT. & TRADEMARK OFF. SOC'Y 833 (1994).

> With the increasing mobility of employees, the diversification of plant sites, the ability to rapidly duplicate and transmit information and the rising cost of litigation, companies face a formidable task in protecting trade secrets. Key people should be identified early in their careers and given the incentives to keep them loyal to their employer.

Id. at 838–39. At the same time, some recent cases have suggested an expansive, pro-employer departure in trade secret law: the "inevitable disclosure" doctrine. As its name suggests, courts adopting this doctrine *presume* that an ex-employee will eventually disclose sensitive information to his new employer. This is said to justify a broad injunction restricting or preventing the new employment. *See, e.g.*, PepsiCo v. Redmond, 54 F.3d 1262 (7th Cir. 1995); MERGES ET AL., *supra* note 159, at 90–93. Inevitable disclosure has been criticized by some who understand the net benefits of employee mobility and robust startup activity. *See* EarthWeb, Inc. v. Schlack, No. 99 Civ. 10035, 1999 WL 980165, at *10 (S.D.N.Y. Oct. 27, 1999) ("Absent evidence of actual misappropriation by an employee, the doctrine should be applied in only the rarest of cases."); 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.

While many startups begin life with the blessing of the founders' prior employer (and sometimes with a capital investment as well), this does not mean that the prior employer could have stopped the new venture. It seems often to be more a matter of "if you can't beat them, join them." The willingness of a parent firm to acquiesce in a startup venture often stems from the startup firm's focus on a niche market or technology in which the parent firm has no interest. Indeed, it might be argued that since employees have private information about prospective inventions at the pre-conception stage of the process, they will tend not to exit when the invention is likely to be so highly complementary to the employer firm's technology that the firm is the only likely licensee of the new invention. There is no reason to exit, in other words, when exit (and ownership) leaves the employee in the same basic bargaining position as before — i.e., heavily reliant on the employer firm for future compensation.[180]

2. "Trailer Clauses" and Public Policy Constraints

Aside from trade secret law, another common employer precaution can in some cases interfere with startup activity. Employers typically include a "trailer" or "holdover" clause in employment contracts which provides that inventions made or conceived within a certain period after the end of employment belong to the employer. Although sweeping on

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575, 624 (1999) ("[T]he inevitable disclosure doctrine threatens just the type of knowledge spillover that has been so critical to Silicon Valley.").

180. Preliminary and partial support for this thesis comes from cases involving blocking patents: very few of the reported cases involve ex-employees or their firms. *But see* New Jersey Zinc Co. v. Singmaster, 71 F.2d 277 (2d Cir. 1934).

> The improvements . . . may not be obtained by assignment to the [employer] because of [the employee's] prior contractual obligation, for these improvements are not shown to have been made or discovered while the [employee] was in the [employer's] employ. . . . The prior patentee cannot use the improvement without the consent of the improver, and the latter cannot use the original invention [assignable under employment agreement] without the consent of the former. The law recognizes the validity of both patents, where the second is an improvement of the first, and neither of the two patentees can lawfully use the invention of the other without the other's consent. An employee is not forbidden, after leaving the service of his employer, from giving expression to inventive thoughts and ideas and indeed making improvements upon basic patents which have become the property of his former employer. Exercise of talents resulting in invention after termination of the employer-employee relationship entitles the employee to a grant of a patent and patent protection.

Id. at 279–80 (citations omitted). On blocking patents generally, see Merges, *The Case of Blocking Patents*, *supra* note 49.

their face, these contracts are not fully enforced: courts universally apply a reasonableness or public policy limitation to them. Their effective scope is therefore much narrower than might appear at first.

One line of cases completely voids agreements that last too long after employment, e.g., one year.[181] Under the cases, ex-employees can always wait until the expiration of the trailer period to perfect an invention. Another line of cases holds that trailer clauses cover only inventions made using the ex-employers' trade secrets.[182]

Trailer clauses have limited effect; they are best seen as particular applications of post-employment covenants not to compete, which have long represented a suspect class of obligations and are often voided under common-law restraint of trade principles. Thus, the legal policy behind trailer clauses, and the law of employee exit generally, tends to favor employee departure. Firms have responded with corporate venture funds, on the theory that if an employee is going to leave anyway the firm might as well try to profit from it. And even beyond this, with an (often implicit) exit option lurking in the background, firms have been forced to improve the lot of those employees who choose to stay. Internal invention reward programs in particular appear designed to offer at least some invention-specific rewards to employees who make significant inventions. In all these ways, looking behind the stark ownership rules exposes a much more complex — and much more pro-employee — set of policies in place.

VI. Conclusion

Employer ownership of inventions makes eminent sense. When four distinct bodies of economic theory point to the same conclusion, there is little room to argue against employer ownership on pragmatic grounds. Employer ownership does not seem unfair, either, considering the overall reward system for employed inventors. This reward system begins with normal salary increases for productive R&D employees. Beyond this, internal reward plans, together with the subtle increment to bargaining leverage that comes as a result of the law's exit option, increase inventor compensation for specific inventions at less cost to employers than outright employee ownership. Thus, judicial enforcement of employee reward plans makes sense; so too does

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181. *See, e.g.*, Armorlite Lens Co. v. Campbell, 340 F. Supp. 273, 275 (S.D. Cal. 1972); Dorr-Oliver, Inc. v. United States, 432 F.2d 447, 451–52 (Ct. Cl. 1970); Ingersoll-Rand Co. v. Ciavatta, 524 A.2d 866, 870 (N.J. Super. Ct. 1987). These cases explain why many trailer clauses are written to expire after six months.

182. *See* Edward L. Raymond, Annotation, *Construction and Effect of Provision of Employment Contract Giving Employer Right to Inventions Made by Employee*, 66 A.L.R.4th 1135, 1202–04 (1992).

rejection of restraints on employee mobility. There is no possible argument, including vague appeals to fairness, for overturning the law's strong presumption favoring employer ownership of employee inventions.

The law of employee inventions may hold broader lessons for the recent debate over the optimal scope and granularity of property rights. The current tradition of granting many discrete patents may appear to create an anticommons — a situation where too many fine-grained rights are granted, requiring prohibitively high transaction costs to form economically useful bundles of rights. However, the law remedies the anticommons problem, not by restricting the grant of rights, but by permitting ex ante contracts that pre-integrate rights. In this way, the benefits of many discrete rights are preserved without incurring excessive ex post transaction costs. The same approach might work in other areas where many property rights create an anticommons dynamic.