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# Trade Secrets and Mutual Investments\*

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**Preliminary Draft**

## Abstract

This paper employs an optimal contracting framework to study the question of how courts should adjudicate disputes over valuable trade secrets (such as customer lists). We focus principally on contexts where trade secrets are formed endogenously, through specific, non-contractible investments that could potentially come from either employers or employees (or both). Within such contexts, we argue, an “optimal” trade secret law diverges in many important respects from existing doctrine. In particular, an optimal doctrine would (1) expressly consider the parties’ relative skills at making value-enhancing investments rather than the mere existence of a valuable informational asset; (2) tend to favor ‘weak’ entitlements (such as fractional property rights and/or liability rules) rather than undivided property rules; and (3) frequently have a dynamic structure that progressively favors employees during the lifetime of the disputed asset. Moreover, we argue, the considerations implicit in such a doctrine are relatively simple, and need not impose prohibitive administrative costs on either the parties or on courts.

## 1 Introduction

Lurking in the shadow of today’s highly mobile, highly skilled labor force, an old question has taken on renewed importance: Who owns valuable information generated within the workplace? The resurgence of this question is, in many ways, only mildly surprising. Indeed, in contrast with the traditional conception of the employment relationship, it is increasingly common for both employers and employees to stake legitimate ownership claims to such information. Consider, for example, the (almost canonical) case of a detailed customer list for

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a business that matches up highly skilled workers with customers possessing idiosyncratic preferences and needs.<sup>1</sup> Once the employee has amassed and nurtured a regular clientele base, she may be tempted to forge ahead on her own, soliciting the patronage of those customers with whom she worked (and perhaps even some with whom she did not). The erstwhile employer, alarmed at the prospect of losing its installed goodwill (and anxious to deter future appropriations), may attempt to enjoin such actions, alleging that the employee has wrongfully appropriated trade secrets that took both time and effort to build.<sup>2</sup>

If, as is often the case, a court is eventually called upon to clarify the parties' respective rights and obligations, situations such as this can prove to be exceedingly difficult to adjudicate: In the above example (as in a significant number of modern trade secret disputes), both the employer and the employee may take partial credit for important (but unverifiable) investments in value-enhancing information, especially consumer goodwill. To simplify a bit, one might think of such investments as falling within two principal categories: (1) "aggregate" investments (such as advertising, product packaging, or market research), which tend to attract new customers; and (2) "individuated" investments (such as the enthusiasm, attentiveness, or quality of work done by the service provider), which tend to retain the loyalty of existing customers. Either of these categories of investment — or both in combination — can effectively enhance brand loyalty for an individual consumer. Moreover, casual observation suggests that, at least on the whole, aggregate investments are usually borne by the employer while individuated investments are borne by the employee. In such circumstances, deciding who among the investing parties has the greater claim of residual ownership is no simple matter.

Courts have not been completely insensitive to the dilemma described above. For example, a number of jurisdictions attempt to make doctrinal distinctions between "route" and "non-route" customers for purposes assessing trade secret status.<sup>3</sup> A "non-route" customer is one who tends to purchase from a number of different suppliers, and exhibits little brand loyalty (such as a long distance telephone customer). Here, courts have recognized (at least implicitly) that nonroute customers — virtually by definition — possess a willingness to purchase that is insensitive to anything other than price. As such, specific investments in enhancing customer goodwill within such industries are unlikely to prove effective or durable. Consequently, courts have felt confident in favoring preferences for market competition over concerns for protecting specific investments, and have routinely denied trade secret protection to employers.

In contrast, "route" customers tend to purchase repeatedly and exclusively from the same supplier. Implicit in this repeat interaction is some propensity toward brand loyalty, and thus a potentially high value of investments in goodwill. In contexts involving route customers, one might surmise (correctly, as

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<sup>1</sup>See, e.g., *Town & Country House & Home Services, Inc. v. Newberry*, 3 NY2d 554 (1958).

<sup>2</sup>Although the title of this paper refers to 'trade secrets,' our analysis carries over to a number of related informational assets generated at the firm that might be used by a departing employee to compete.

<sup>3</sup>See Section II, *infra*.

it happens) that courts would be more willing find that a trade secret exists. However, as seems evident even in the case law, there is a fair amount of heterogeneity in the factual premises of such cases: consumer loyalty may well be fostered principally by employer-borne investments in some situations, but employee-borne efforts in others. Thus, while route-customer status may be a good indication that a trade secret exists, it alone does not answer the ultimate question of *who* should receive the rents that emanate therefrom. Nevertheless, apparently untroubled by this fundamental indeterminacy, courts regularly cite route customer status as a rationale for granting an employer protection.

Regardless of how a court arrives at its conclusion to protect such information, once it so decides the remedy for misappropriation is ubiquitously severe. Indeed, most jurisdictions allow for the aggrieved party to obtain injunctive relief, or — if such relief is infeasible — the plaintiff may obtain a financial remedy calculated to disgorge the *entire profit* of the appropriating defendant rather than simply offset the loss of the plaintiff.<sup>4</sup> This combination of equitable relief and gains-based remedy reflects a form of entitlement protection that (using the Calabresi-Melamed parlance) is much more akin to a property rule than a liability rule.

This paper addresses the normative question of whether (and how) trade secret and related doctrines should explicitly account for the sort of mutual investment contexts described above. We argue that they should, and that the requisite reforms for accomplishing the task, while perhaps considerable, are worth our collective effort.

Our methodological approach for studying the problem largely tracks an optimal-contracting framework, defining an ‘optimal’ trade secret doctrine as that which best mimics the terms of a joint-welfare maximizing contract between the parties.<sup>5</sup> Analyzing a game-theoretic model of contracting within this framework, we present the following arguments. First, so long as one assumes (plausibly, we think) that employer- and employee-borne investments *are not* perfect substitutes for one another, it is generally impossible to come up with a contract that gives rise to “first-best” investments by both parties. The intuition here is simple and well-known in the literature: no matter how the marginal returns are split, they *are still* split. Hence, the employer and employee must share the marginal benefit of their individual investments while bearing the entire marginal cost personally.<sup>6</sup>

Despite this endemic inefficiency, it is still important to ask which doctrine (or doctrines) minimize the inefficiency that occurs in equilibrium. If courts are constrained (as current practice suggests) to decide solely about whether to award the employer with an undivided property right, we argue, the optimal

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<sup>4</sup>See, e.g., the Uniform Trade Secrets Act, Cal. Civ. Code § 3426 (2000) (et seq.). The damages section of the code actually disaggregates the remedy into two parts: (1) a reasonable royalty, plus (2) any provable unjust enrichment beyond the reasonable royalty. These two elements are not mutually exclusive. *Id.*

<sup>5</sup>There are, to be sure, other definitions of optimality; but this one provides a useful benchmark that is common in the literature. See, e.g., Rubin & Shedd (1981).

<sup>6</sup>See, e.g., Holmstrom (1982).

doctrine would tend to do so only if the employer enjoys a sufficiently large comparative advantage vis à vis the employee in enhancing consumer goodwill. Furthermore, there is no a priori reason to think that such considerations generally favor employers, particularly in contexts involving highly-skilled employees.

This last observation spawns a larger set of arguments on which we concentrate at greater length—arguments relating not only to *whether* an employer should receive an entitlement to a trade secret, but also to *what form of protection* she should receive. Indeed, an optimal legal entitlement regime need not be limited to choosing among undivided property rules. To the contrary, we show that there are many circumstances in which an optimal contract would assign some form of divided entitlement to the parties. Such divided entitlements may take a number of forms, ranging from an outright Solomonic division of the disputed asset (when feasible), to probabilistic assignment, to protection through a liability rule in which the employee effectively receives a ‘call option’ over the post-employment use of the trade secret. This implication stands in stark contrast with current doctrine, which prescribes much stronger remedial medicine, consisting of either injunctive relief or a disgorgement remedy designed to deter post-employment competition completely.<sup>7</sup>

Finally, we argue that an optimal trade-secret doctrine may be dynamic rather than static in nature. In particular, we conjecture that “aggregate investments” (as defined above) are likely to be most critical early on in the customer relationship, while “individuated investments” come to predominate later on. If employers largely bear the former while employees bear the latter, then one obvious implication is that trade secret law should progressively become *less* protective of the employer during the lifetime of the disputed asset. Interestingly, current doctrine tends to militate at least partially in the opposite direction, affording greater protection to long-standing components of goodwill than to recent ones.<sup>8</sup>

This is hardly the first paper to consider trade secret protection from a transaction cost perspective. Anton and Yao (1994), for example, consider a model in which a capital-constrained inventor with no intellectual property protection for her invention must negotiate with prospective investors who are conceivably able to expropriate its value. They show that even in such extreme circumstances, the inventor can still profit by disclosing her information to a single purchaser, who is willing to remunerate her generously in exchange for securing her silence toward other potential competitors. Their analysis, while thought-provoking, says little about setting mutual incentives to create information, whether the lack of intellectual property rights is in any way optimal from an efficiency perspective, or whether some forms of partial protection are

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<sup>7</sup>See note 3, *supra*.

<sup>8</sup>Although the Uniform Trade Secrets Act’s definition of “trade secret” rests only on economic value and efforts to maintain secrecy (e.g., Cal Civ. Code § 3462 et seq. (2000)), a number of cases appear to hinge protection — at least in part — on the time and effort required to amass the knowledge initially. See, e.g., *Town & Country House & Home Services, Inc. v. Newberry*, 3 NY2d 554; 170 NYS2d. 328; 147 NE2d 724 (NY 1958); *Corroon & Black v. Hosch*, 109 Wis.2d 290 (Wis. 1982).

preferable to others.

Zábojník (2000) analyzes trade secret protection in the context of a transaction-cost environment. He argues that when trade secrets are distributed throughout a firm's hierarchy and easily communicable to competitors, an optimal organizational form may purposely leave certain "low level" trade secrets unprotected, thereby allowing the firm to avoid ratcheting up salaries throughout its employee ranks (which would otherwise be necessary to deter defections). For the same reason, Zábojník argues, mid- and upper-level managers within the firm may have the opposite incentive, and will over-protect the firm's existing informational assets. Like Anton & Yao, however, Zábojník's analysis implicitly assumes that trade secrets are simply unprotectible in court, and he therefore does not consider the question of how the legal environment interacts with joint investments in goodwill.

More closely related to our analysis is Aghion & Tirole (1994), which also analyzes a model of two-sided investment in informational assets.<sup>9</sup> Though their framework is not expressly rooted in a trade secret context, they argue (as do we) that an optimal property rights assignment turns on an analysis of who, on the margin, is the most productive party at creating 'value.' Their analysis, however, fails to capture two fundamental aspects of the usual legal environment surrounding such disputes. First, Aghion and Tirole limit their attention to alternative allocations where one of the parties always receives an *exclusive* property right to the disputed asset. Such a framework is inconsistent with a typical trade secret dispute, in which a judge must decide between granting property rights to the employer on the one hand, or (essentially) not granting any at all, permitting the employer and employee both to utilize the disputed asset in subsequent competition.<sup>10</sup> Second, Aghion and Tirole's analysis is devoted exclusively to identifying the correct entitlement holder, but says little about how her entitlement should be protected (e.g., through injunctive relief or damages). Our analysis employs a framework that both captures the more germane aspects of legal disputes and allows for a court to choose among a wide variety of entitlement forms (or even a combination thereof) as a means for protection.

More generally, our principal arguments tap into a current academic dialogue over the relationship between the protection of intangible assets and overall economic growth. Some U.S. jurisdictions (such as California) are widely thought to provide relatively weak protection to workplace-generated information in the face of an employee's departure.<sup>11</sup> A number of legal scholars (e.g., Gilson

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<sup>9</sup>Philippe Aghion & Jean Tirole, *The Management of Innovation*, 109 Q.J. Econ. 1185 (1994)

<sup>10</sup>Hyde (2000) has also articulated this criticism.

<sup>11</sup>See Cal. Bus. & Prof. Code §16600-16602.5 (prohibiting non-compete covenants beyond those attached to sale of goodwill of a business, or upon dissolution of partnership or limited liability corporation). See also Ala. Code §8-1-1; Colo. Rev. Stat. §8-2-113; Haw. Rev. Stat. §480-4(c); La. Rev. Stat. Ann. 23:921; Mont. Code. Ann. §§28-2-703, 704; N.C. Gen. Stat. §75-4; N.D. Cent. Code §9-08-06; Okla. Stat. tit. 15, §217.

It should be noted as well that many California firms appear to limit their exercise of even those legal rights available to them under trade secret law, whether because of California juries'

(2000); Hyde (2000)) have speculated that the success of Silicon Valley relative to other high-technology industrial districts may be due (at least in part) to California’s weak restrictions on post-employment competition. The kernel of this argument is that weak protection within “high velocity” labor markets—where highly-skilled employees move fluidly between firms taking ideas and innovations with them—permits the rapid diffusion of information, leading to industry-wide technological gains that arguably swamp the investment disincentives that weak entitlements may engender.<sup>12</sup> Our analysis contributes to this enterprise, but *not* by arguing that weak legal protection enhances informational diffusion. Rather, we argue that at least in contexts where mutual investments are important, ‘weak’ entitlements can actually catalyze aggregate investment itself, by incentivizing employees.<sup>13</sup>

Our analysis proceeds as follows. Section 2 of the paper describes the law of trade secret protection and restrictive covenants in greater detail, emphasizing the prevailing judicial tests surrounding (i) when an employer may obtain protection over informational assets generated in the firm, and (ii) what remedy usually protects that entitlement. This analysis (and the observations emerging therefrom) provide the doctrinal benchmark for Section 3, which explores a game-theoretic model of contracting over the allocation over trade secrets. We use this framework to illustrate how an ‘optimal contract’ might frequently depart from existing doctrine. In particular, an optimal doctrine would expressly account for the relative skills of employers and employees in enhancing customer goodwill. Moreover, such a contract would frequently employ various types of ‘divided’ entitlements (noted above) to protect the entitlement rather than undivided property rules. In fact, Section 3 goes even further, demonstrating that many divided entitlement choices are actually theoretical ‘duals’ of one another: that is, each of them could independently be used to support an optimal contract. Section 4 considers a number of caveats and extensions of the analysis, including a formalization of the duality argument and its doctrinal applications, an assessment of whether the doctrinal reforms we advocate are administratively feasible, and the extension of our framework to a dynamic context. Section 5 concludes. (An appendix to this paper contains all of the pertinent proofs of the propositions stated in the main text).

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reluctance to convict defendants except in the most clear-cut cases, or due to the reputational costs of bucking norms that tolerate employee mobility (norms that may have emerged as a result of the background rules pertaining to covenants). Gilson (2000) at 600-601; Hyde, (2000), at 31-2.

<sup>12</sup>Gilson (2000), at 608-609; Hyde (2000), at 29.

<sup>13</sup>Importantly, our notion of ‘weak’ entitlements is not meant to imply that an optimal contract would remove any liability for departing employees. For instance, as will become apparent below, an optimal liability rule might impose strict liability on a competing former employee, while simultaneously placing a ceiling on her exposure to damages.

## 2 The Law Protecting Investments in Customer Relationships

The law of agency imposes a duty of loyalty on an employee during the tenure of the agency relationship. This duty prohibits, among other things, solicitation of the employer’s customers.<sup>14</sup> After departure from the firm, however, an employee may, as a general matter, solicit the former employer’s customers, unless it involves misappropriation of trade secrets or confidential information, or breach of a non-compete covenant.<sup>15</sup>

### 2.1 Trade Secrets and Confidential Information

Trade secrets law governs a significant proportion of disputes between employers and their former employees over rights to customer goodwill. Accordingly, the field has become somewhat statute-oriented in recent years. About two-thirds of the states have adopted the Uniform Trade Secret Act (UTSA), which defines a trade secret as follows:

“Trade secret” means information, including a formula, pattern, compilation, program, device, method, technique, of process, that:

(i) derives independent economic value, actual or potential, from not being generally known to , and not being readily ascertainable by proper means by, other persons who can obtain economic value from its disclosure or use, and

(ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.<sup>16</sup>

Although a number of possible assets might fall within this definition, customer lists are commonly recognized as an important component of a firm’s trade secrets.<sup>17</sup> The inclusion of customer lists, moreover, is by no means a

<sup>14</sup>*Bancroft-Whitney Co. v. Glen*, 49 Cal. Rptr. 825 (1966); *Jet Courier Service, Inc. v. Mulei*, 771 P. 2d 486, 495 (S. Ct. Colo. 1989); *ABC Transnational Transport, Inc. v. Aeronautics Forwarders, Inc.*, 413 N.E. 2d 1299, 1305-06 (Ill. Ct. App. 1980); *Duane Jones Co, Inc. v. Burke*, 117 N.E. 2d 237, 245 (N.Y. 1954); *Mallory Factor, Inc. v. Schwartz*, 536 N.Y.S. 2d 752 (1989).

<sup>15</sup>*Columbia Ribbon & Carbon Mfr. v. A-1-A Corp*, 369 N. E. 2d 4 (N.Y. 1977); *Cosmos Forms Ltd. v. American Computer Forms, Inc.*, 596 N.Y.S. 2d 862 (1993) (citing *Reed, Roberts Assocs. v. Straumann*, 353 N.E. 2d 590 (N.Y. 1976); *Gordon Termite Control v. Terrones*, 148 Cal. Rptr. 310 (1978); *Veco Corp. v. Babcock*, 611 N.E. 2d 1054, 1061 (Ill. Ct. App. 1993); *Gary Van Zeeland Talent Inc, v. Sandas*, 267 N.W. 2d 242, 252 (Wis. 1978) (citing *American Welding & Engineering Co., Inc. v. Luebke*, 155 N.W. 2d 576 (Wis. 1968).

<sup>16</sup>Uniform Trade Secrets Act, §1(4) (1985).

<sup>17</sup>While our subsequent analysis fits most conveniently into a ‘customer list’ category, any piece of information that has either cost- or revenue-based implications, and whose value is subject to dissipation by wide disclosure would fit into our analytical framework.

Note that at least one state has modified the UTSA definition to include customer lists explicitly: Illinois defines a trade secret as, “ information, including but not limited to, technical or non-technical data, a formula, pattern, compilation, program, device, method, technique,



recent phenomenon: the Restatement (First) of Torts also memorialized the recognition of customer lists as potential trade secrets.<sup>18</sup>

The critical inquiry for purposes of our analysis is whether and how courts assess the parties' respective contributions to the creation of goodwill in deciding whether to recognize a trade secret, and thus whether to allow the employer (as is typically the case) to enjoin the former employee's appropriation of the disputed intangible asset.<sup>19</sup> As our discussion below illustrates, existing law does not generally account for the relative importance of employee contributions in developing such assets, but rather tends to hinge trade secret protection almost exclusively on the existence of a valuable informational asset irrespective of how it was generated.

Above all other things, trade secret status turns centrally on whether the disputed asset has predominantly an *informational* value. Protection is generally unavailable unless the alleged trade secret contains information that is not already known to members of the trade, or readily ascertainable through public sources (e.g., telephone books and trade publications).<sup>20</sup> In addition, courts frequently also emphasize the effort and expenditure on the part of the employer in developing the list.<sup>21</sup> To this end, evidence of significant employer investment appears to serve as a type of doctrinal proxy for information that

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drawing, process, financial data, or list of actual or potential customers or suppliers. . . . Ill. Rev. Stat. Ch. 140 ¶352.

<sup>18</sup>See Restatement (First) of Torts, §757, Comment (b) (a trade secret “ may be a formula or chemical compound, a process of manufacturing, treating or preserving materials, a pattern for a machine or other device, or a list of customers.” ).

<sup>19</sup>State common law idiosyncrasies have led to variations in the precise details of how courts treat customer goodwill. Rather than exhaustively reviewing the approaches of the various states, we will simply describe general trends.

<sup>20</sup>See, e.g., *Carbonic Fire Extinguishers Inc. v. Heath*, 547 N.E. 2d 675, 677 (Ill. App. 1989) (rejecting plaintiff's request for trade secret protection on basis that information was readily available) (citing the pre-UTSA case of *Lincoln Towers Ins. Agency v. Farrell*, 425 N.E. 2d 1034 (Ill. App. 1981) (noting the range of factors considered, but then noting that the confidentiality factor must be present for there to be protection)); *Ivy Mar Co., Inc. v. C.R. Season, Ltd.*, 907 F. Supp. 547, 558 (E.D.N.Y. 1995) *Ivy Mar, id.*, 907 F. Supp. at 558 (citing *Reed, Roberts, Assocs. v. Strauman*, 353 N.E. 2d 590, 54 (1976)). Also see generally, Melvin F. Jager, *Trade Secrets Law* §3.05[6][b][I] (May 2000 update) (customer list cases arising under the UTSA generally turn on meeting the requirement of not being readily ascertainable); See Restatement (Third) of Unfair Competition, §42, Comment (f) (customer list may be protectible as a trade secret if information is sufficiently valuable to afford economic advantage to the person who has access to the list, and if the potential customers are not readily identifiable without the list).

<sup>21</sup>*Courtesy Temporary Services, Inc. v. Camacho*, 272 Cal. Rptr. 352, 357 (1990); *Stampe Tool Warehouse, Inc. v. May*, 651 N.E. 2d 209, 241 (Ill. App. 1995), appeal denied, N.E. 2d 639 (1995) (customer list was protectible based on the fact that the employer had developed the list through laborious methods that required time, effort and expense, that no such list was readily available from any public source, and that the employer had made reasonable efforts to protect the secrecy and confidentiality of the list); *Nalco Chemical Co. v. Hydro Technologies, Inc.*, 984 F. 2d 801 (7th Cir. 1993) (citing *Gary van Zeeland Talent, Inc. v. Sandas*, 267 N.W. 2d 242 (Wis. S. Ct. 1978) (emphasizing both protection of secrecy of list, and employer investment in developing list) CHECK THIS; *Ivy Mar, id.*, 907 F. Supp. at 556-57 (E.D.N.Y. 1995) (citing *Leo Silfen, Inc. v. Cream*, 278 N.E. 2d 636, 639 (1972)) (customer lists protectible as trade secrets only where considerable time and effort has been invested in compiling the list of names, and the names are not readily ascertainable).

gives the employer a competitive advantage vis à vis other providers. As a New York district court recently emphasized:

[W]here years of business effort, advertising, and enterprise have allowed the employer to secure the goodwill of customers whose availability as patrons would not be readily ascertainable from public sources, the former employee may be enjoined from soliciting those customers.<sup>22</sup>

A particularly striking feature of this excerpt is the absence of any express consideration of how (or whether) the efforts of the employee potentially played a role in developing the customer goodwill. To the contrary, it is often the case that evidence of employee effort actually buttresses the *employer's* argument for protection, usually based on the dual doctrinal premises that the employee's efforts were effectively 'purchased' by the employer, and that appropriation of those special relationships would be an act of unfair competition by the former employee.

These themes are particularly well drawn in jurisdictions that still recognize what has become known as the "route / non-route" distinction. An early and influential California precedent involving a floor treatment company seeking to enjoin two former employees from using its customer list is typical.<sup>23</sup> The employer was unable to secure trade secret protection in part because it failed to demonstrate an established, regular relationship between the defendant employees and its customers. This was dubbed a "non-route" case because the former employer competed openly for its clientele, rather than having secured a select, brand-loyal group of customers through its "routemen."<sup>24</sup> By negative implication, an employer who can demonstrate that her customers were "route" customers stands a significantly greater chance of securing trade secret protection.

The route / non-route distinction seemed motivated by two principles. First, the exclusivity of the client base was a surrogate for the confidentiality of the information. Second, the involvement of the employee in "working" that trade route permitted the employee to gain a unique or specialized type of knowledge through the confidential relation with his employer, and thus the capacity to exploit that confidential knowledge unfairly for gain.<sup>25</sup> Modern customer list cases in California reveal their roots<sup>26</sup> in the route/non-route analysis. The success of a trade secret claim turns not only on whether the customer list is readily ascertainable by members of the trade, but also on whether the customer's decision to purchase was based primarily on consideration of price, quality, reliability and other generic competitive factors, or whether the decision instead

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<sup>22</sup>Ivy Mar. id., 907 F. Supp. at 557 (quoting American Institute of Chemical Engineers v. Reber-Friel Co., 682 F. 2d 382, 387 (2d Cir. 1982)). GET CORRECT QUOTE

<sup>23</sup>Continental Car-Na-Var Corp. v. Mosely, 148 P. 2d 9 (Cal. S. Ct. 1944).

<sup>24</sup>Id. at ??.

<sup>25</sup>State Farm Mutual Auto Ins. Co. v. Dempster, 344 P. 2d 821, 825 (Cal. App. 1959); American Loan Corp. v. California Commercial Corp., 27 Cal. Rptr. 243, ??? (1963).

<sup>26</sup>Pardon the pun.

turned on the employer or employee's knowledge, acquired through effort, of a particular idiosyncrasy of the customer's preferences or needs.<sup>27</sup> A few other jurisdictions take a similar tack, holding that the more idiosyncratic knowledge the employer has acquired about its customer's tastes and purchasing habits, the greater the prospects for trade secret protection.<sup>28</sup>

A point worth emphasizing here is that—at least among reported cases—the customer-specific information at the core of many disputes is often the product of an employee's individual dealings with the customer base over an extended period of time. Indeed, even in states that do not explicitly follow a route / non-route line of precedent, the intimate nexus between employee and customer often biases a court towards granting trade secret protection to the employer. In one recent New York decision, the employee's own affidavit that it was “due to the rapport that she, as the plaintiff's employee, had developed with some of the plaintiff's customers which induced them to become her customers,” convinced the court that the customer list could not, in fact, be readily ascertained (a factor cutting in favor of trade secret protection).<sup>29</sup> It is not unusual for evidence of “friendly contact” between the former employee and the contested customers to strengthen the employer's claim for protection, not so much because the courts actively discredit the element of human capital investment in those relationships to which the employee may rightly lay at least some claim, but on the theory that a former employee's use of his knowledge of customer buying habits and requirements may constitute unfair competition.<sup>30</sup> A small number of jurisdictions have allowed for the possibility of exempting selected names from a customer list from protection, based on the efforts of the former employee in developing personal goodwill with those customers.<sup>31</sup> This practice would seem to recognize the desirability of taking into account the respective investments of the parties in deciding how property rights in customer goodwill should be allocated.<sup>32</sup> This alternative approach, however, does not seem (as

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<sup>27</sup>Hollingsworth Solderless Terminal Co. v. Turley, 622 F. 2d 1324, 1332-35 (9th Cir. 1980) (listing factors). [find actual quote, or at least check to see paraphrase is correct]. Note that in California, the decision also turns on whether the former employee, in addition to intending to appropriate its customers, also intended to harm the former employer's business.

<sup>28</sup>See, e.g., Abbott Laboratories v. Norse Chemical Corp., 147 N.W. 2d 529, 539 (Wis. S. Ct. 1967) (declined to protect the customer list in question as a trade secret, reasoning in part that the list contained non-route customers. Court also held that customer lists are not trade secrets unless they contain more than mere names and addresses: they must contain more detailed information about the market needs and habits of the customers); Nalco Chemical, id., 984 F. 2d 801 (citing Minuteman, Inc. v. Alexander, 434 N.W. 2d 773, 779 (Wis. S. Ct. 1989)) (anything in dicta saying that this is a modern version of route / non-route?); Colonial Laundries, Inc. v. Henry, 48 R.I. 332 (criticized on other grounds by Callahan v. Rhode Island Oil Co., 103 R.I. 656 (19—)).

<sup>29</sup>HBD, Inc. v. Ryan, 642 N.Y.S. 2d 913, 914 (1996). (COVENANT CASE – affirmed partial summary judgment on issue of former employee's liability for breaching covenant not to compete by working for former customers within a particular time and place).

<sup>30</sup>See page 40 ALR Treatise. [Need more on this—cases go both ways in other jurisdictions on “friendly relationships.” ]

<sup>31</sup>Moss, Adams & Co. v. Shilling, 224 Cal. Rptr. 456 (1986) (citing King v. Pacific Vitamin Corp., 64 Cal. Rptr. 486 (1967)).

<sup>32</sup>Any language from Moss in this vein?

of yet) to have been adopted widely.<sup>33</sup>

Finally, even where customer information does not meet the definition of trade secret, an employee may be enjoined from soliciting her former employer's customers. In some cases, sustained effort in developing the list may actually substitute for the requirement that the list be secret. Where the list was compiled through sustained efforts in investigating and soliciting customers, whether by the employer or by the employee on behalf of the employer, it may be conceived as a valuable asset over which the employer may legitimately seek protection. A cause of action may lie in unfair competition, which recognizes a duty to refrain from using information obtained during employment that would give the employee an unfair advantage.<sup>34</sup> The status of mere information about customer idiosyncrasies (where the identity of the customer is available from public sources) is, at present, more ambiguous. Some courts have held that an employee cannot be enjoined from recalling and using details about the preferences and consumption habits of particular customers, so long as that information could be recalled simply by contacting the customer directly.<sup>35</sup> Others have held an employee liable for breach of the duty of confidentiality for "referring to his or her knowledge of their business acquired during the employment."<sup>36</sup>

To summarize, in the main, neither trade secret doctrine nor the closely linked doctrine of unfair competition prescribe any significant assessment of the role and strength of the employer and employee investments in customer relations. If a customer list is found to be a trade secret, is because—akin to a secret recipe—it was not generally known to the public, and at some point required a costly investment on the part of the employer both in terms of its

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<sup>33</sup>A recent Court of Appeal decision in California may signal a retraction of earlier common law precedent under the UTSA. In *Morlife v. Perry*, the court indicated that if a customer list is protectible as a trade secret, a former employee is prohibited from using the information contained in the list, regardless of whether that employee was personally responsible for developing any of the customers during the period of employment. *Morlife, Inc. v. Perry*, 66 Cal. Rptr. 2d 731 (1997).

<sup>34</sup>See, e.g., *Panther Systems II, Ltd. et al v. Panther Computer Systems Inc.*, 1991 WL 317029 (E.D.N.Y. November 29, 1991), p.13, (citing *Abraham Zion Corp. v. LeBow*, 593 F. Supp. 569 (S.D.N.Y. 1984), aff'd 761 F. 2d 93 (2d Cir. 1985) (employer can enjoin a former employee from soliciting customers if it can be shown that the employee would not have known about the customers "but for information obtained during his prior employment"); *Courtesy Temporary Services, Inc. v. Camacho*, 272 Cal. Rptr. 352, 360 (noting that even if customer list didn't meet definition of trade secret, unfair and deceptive practices of employees in stealing plaintiff's customers should have been enjoined under California Business and Professions Code, section 17200 et seq.) CHECK TO SEE IF THIS IS CURRENT OR FORMER EES.

ALSO CHECK the following cases to see whether they recognize a stand-alone (no trade secret and no covenant) basis for enjoining employee solicitation, and if so, what elements are required for a cause of action: *Continental Dynamics Corp. v. Kanter*, 408 N.Y.S. 801 (1978); *American Bldgs. Co. v. Pascoe Bldg. Systems Inc.*, 392 SE 2d 860; *Numed, Inc. v. McNut*, 724 S.W. 2d 432 (Tex. App. 19\_) (criticized on other grounds in *Miller Paper Co. v. Roberts Paper Co.*, 901 S.W. 2d 593 (Tex. App. 19\_); *Camden v. South Jersey Port Com*, 63 A. 2d 552 (N.J. 19\_), mod on other grounds, 73 A. 2d 55; *Byars v. Stone*, 42 SE 2d 847.

<sup>35</sup>*Ivy Mar*, 907 F. Supp. at 557-58; *Walter Karl, Inc. v. Wood*, 528 N.Y.S. 2d 94, 98 (1988); *Catalogue Services of Westchester, Inc. v. Henry*, 484 N.Y.S. 2d 615, 616 (1985).

<sup>36</sup>*John Davis & Co. v. Miller*, 104 Wash. 444, 177 P 323.

development, and in terms of maintaining its secrecy. The employee’s role in developing the asset is at best irrelevant, and at worst constitutes a factor that augments the employer’s claim.

## 2.2 Covenants Not to Compete

Although our analysis revolves principally around default legal rules (in the form of trade secrets law), it is perhaps prudent to briefly address the many instances in which parties attempt to vary trade secret law through a covenant not to compete.<sup>37</sup> Viewed in this light, non-compete agreements regarding post-employment competition serve to supplement (or substitute for) trade secret protections.<sup>38</sup> Covenants not to compete are presumptively unenforceable on public policy grounds, but the doctrine carves out an exception for a covenant that safeguards a “legitimate” or “protectible” interest, and then only if the covenant is reasonable. The reasonableness test balances hardship to the employee against the interests of the public, with specific attention to whether the restriction is excessive in terms of duration, range of activities, or geographic scope.

Protectible interests that satisfy the first prong of the test for enforceability vary from state to state. Probably the most universally recognized protectible interest is trade secrets. Customer goodwill may, as we have explained, be characterized as a trade secret in some instances, thus satisfying the protectible interest prong.<sup>39</sup> Even where it is not a trade secret, customer goodwill may be classified as a legitimate employer interest and hence may be the subject of a covenant not to compete. Indeed, it is not uncommon for the law to single out as protectible the goodwill that the departing employee him or herself cultivated while employed by the former employer.<sup>40</sup> This goodwill component

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<sup>37</sup>A minority of states, such as California, simply deem restrictive covenants unenforceable by statute, though these statutes usually contain narrow exceptions. See Cal. Bus. & Prof. Code §16600-16602.5 (exceptions include covenants attached to sale of goodwill of a business, or upon dissolution of partnership or limited liability corporation). See also Ala. Code §8-1-1; Colo. Rev. Stat. §8-2-113; Haw. Rev. Stat. §480-4(c); La. Rev. Stat. Ann. 23:921; Mont. Code. Ann §§28-2-703, 704; N.C. Gen. Stat. §75-4; N.D. Cent. Code §9-08-06; Okla. Stat. tit. 15, §217.

<sup>38</sup>For explanations of why employers might supplement existing trade secret rights with contractual protections, see Kitch (1980) (arguing that the benefit of contractual protection over trade secrets law is that a contractual prohibition on mobility enable the employer to keep the former employee away from competitors in the first place); and Rubin & Shedd (1981) (use of contractual mechanisms may be a pragmatic response to the difficulty of knowing ex ante whether information will be deemed a trade secret).

<sup>39</sup>*Ackerman v. Kimball Int’l, Inc.*, 634 N.E. 2d 778 (Ind. Ct. App. 1994), vacated in part, adopted in part, 652 N.E. 2d 507, 510-11 (courts will enforce a covenant to protect trade secrets, so long as it meets other requirements of enforceability); *Geritex Corp. v. Dermarite Indus., LLC*, 910 F.Supp. 955, 959 (S.D.N.Y. 1996) (protectible employer interests include trade secrets and confidential customer lists). This is so even in some states, such as California, that statutorily prohibit covenants not to compete. See, e.g., *Loral Corp. v. Moyes*, 219 Cal. Rptr. 836, 840 (1985) (blurb). More direct cites for this proposition?

<sup>40</sup>*Reynolds and Reynolds Co., v. Tart*, 955 F. Supp. 547, 552-53, n.4 (W.D. N. C. 1997) (noting that protectible ‘good will’ is established when an employee, during the course of his or her employment, develops or improves customer relationships) GET SPECIFIC QUOTE

of the employee's human capital is distinguished from general skills, knowledge and expertise the employee acquired while working for the employer, including general "tools of the trade" acquired at the employer's expense, which are usually not protectible.<sup>41</sup> The basis for the distinction appears to be an extension of the unfair competition principles discussed earlier: just as trade secrets are protectible through covenant, the closely related right to be free from unfair competition is also protectible through covenant.<sup>42</sup>

Some states add a caveat, conceptually similar to the route / non-route distinction discussed earlier, that the employer cannot protect its interest in customer relationships unless the relationships have an element of exclusivity. Illinois courts, for example, recognize a legitimate business interest where "customer relationships are near permanent and but for the employer's association with the employer the employee would not have had contact with customers."<sup>43</sup> Thus Illinois, like many states, singles out employers' customer goodwill as meriting extended contractual protection, should the reach of trade secret or confidentiality doctrines somehow prove insufficient. At the same time, it delimits the range of customers protectible as such to those over whom the employer has a de facto monopoly due to a long-standing relationship.<sup>44</sup> Other states,

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FROM CASE; *IDS Life Insurance, Inc., v. SunAmerica, Inc.*, 958 F. Supp. 1258, 1273 (N.D. Ill. 1997) (applying Minnesota law) (Minnesota employers have a distinctly protectible interest in the customers their agents have been hired to develop); *Renal Treatment Ctrs.—Missouri, Inc. v. Braxton*, 945 S.W. 2d 557, 564 (Mo. Ct. App. 1997) (covenant not to compete held unenforceable because it prohibited serving customers that the defendant had not had contact with during the employment, and plaintiff therefore had no protectible interest in those customers as to the defendant).

<sup>41</sup>*Reed, Roberts Associates v. Strausman*, 353 N.E. 2d 590, 593 (N.Y. 1976) (stating that "no restrictions should fetter an employee's right to his own best advantage the skills and knowledge acquired by the overall experience of his previous employment"); *Donahue v. Permacel Tape Corp.*, 127 N.E. 2d 235, 240 (Ind. 1955) ("knowledge, skill and information (except trade secrets and confidential information) become a part of the employee's personal equipment. . . . These things cannot be taken from him, although he may forget or abandon them") (citing *Jewel Tea Co. v. Grissman*, 279 N.W. 544 (1938)).

<sup>42</sup>*Daruger v. Hodges*, 471 S.E. 2d 33, 35-36 (Ga. Ct App. 1996) (employer has a protectible interest in the customer relationship its former employee established at work and a right to protect itself from the risk that the former employee will use contacts so cultivated to unfairly appropriate customers); *Terry D. Whitten, D.D.S., P.C. v. Malcolm*, 541 N.W. 2d 45, 48 (1995) (legitimate interest where employee has had significant personal contact with employer's patients and thus has the opportunity to abscond with former employer's goodwill in the form of patients).

<sup>43</sup>*Lawrence and Allen, Inc. v. Cambridge Human Resource Group, Inc.*, 685 N.E. 2d 434, 443 (Ill. App. 1997) (citing *Capsonic Group v. Swick*, 537 N.E. 2d 1378 (Ill. App. 1989)); *Label Printers v. Pflug*, 564 N.E. 2d 1382, 1387 (Ill. Ct. App. 1991) (protectible interest where employer has "near-permanent" relationship with customers with whom, but for the employment, employee would not have encountered; "near-permanence" is a function of, inter alia, time, cost, and difficulty of developing and maintaining clientele, as well as continuity and duration of relationship), citing *Reinhardt Printing Co. v. Feld*, 490 N.E. 2d 1302 (Ill. Ct. App. 1986).

<sup>44</sup>Opinion as to what constitutes a 'near permanent' relationship is divided in the lower courts, although the so-called "nature of the business" test, which emphasizes \_\_\_\_\_, has enjoyed recent popularity. *Id.*, 685 N.E. 2d at 443-44; *Office Mates 5, North Shore, Inc. v. Hazen*, 599 N.E. 2d 1072 (Ill. App. 1992).

however, have expressly rejected the near-permanence limitation.<sup>45</sup>

The reasonableness analysis is triggered only if the legitimate interest prong is satisfied, but it would be possible, in theory, for this analysis to incorporate an assessment of relative contributions by the parties. The analysis could, for example, invalidate a covenant designed to protect a customer list on the basis of overbreadth if it prohibited solicitation of customers without regard to the relative investments of the parties, as opposed to tailoring the prohibition to customers with whom the former employee had no prior dealings or in whom the employee had made insufficient goodwill-enhancing investments. This, however, is not the case. While the reasonableness analysis may, in fact, take notice of the employee's particular dealing with the contested customers, the significance of such evidence cuts the other way. The doctrine reinforces the tendency of courts to recognize stronger employer entitlements when the contested goodwill was developed partially by the employee. Thus, for example, courts have held that a covenant is overbroad and unenforceable if it prohibits solicitation of the former employer's clients without any geographic restriction, but that the absence of a geographic restriction is not fatal if in its place, the covenant limits nonsolicitation to those clients with whom the employee had contact while still working for the employer.<sup>46</sup> This refinement of the geographic prong of the reasonableness test puts a fine point on our observation about the tilt of the doctrine aimed at balancing employer and employee concerns in limiting workers' post-employment activities. Not only does it fail to weigh the employee's potential contribution to the value of the investment, but it ratifies the parties' decision to selectively protect only those customers with whom the employee has had contact (and an opportunity to enhance the value of the goodwill).<sup>47</sup>

### 2.3 Remedies

As the above discussion illustrates, considerable uncertainty still imbues questions of when the employer possesses an entitlement to trade secrets generated in the workplace, versus when the employee is entitled to use such knowledge to compete with his erstwhile employer. Notwithstanding this uncertainty concerning the *entitlement holder*, however, there appears to be wide consensus in the courts about the *form of protection* that the entitlement holder (once decided) receives. Trade secret law (much like the rest of intellectual property law) has remained unambiguously faithful over the years to using undivided

<sup>45</sup>IDS Life Insurance, *supra*, 958 F. Supp. 1258, 1273 (N.D. Ill. 1997) (applying Minnesota law).

<sup>46</sup>Lawrence and Allen, *supra*, 685 N.E. 2d 434, 441 (Ill. App. 1997) (holding that a restrictive covenant barring employee from soliciting "any client," without geographic restriction, was overbroad, noting that it should be limited to protecting those clients with whom the employee had had the opportunity to develop a relationship); Digitel Corp. v. DeltaCom, Inc., 953 F. Supp. 1486, 1496 (Ala. 1996); Moore Business Forms, Inc. v. Wilson, 953 F. Supp. 1056, 1068 (Ia. 1996).

<sup>47</sup>If one assumes that the employee's compensation fully or partially adjusts for this ex-ante allocation of downstream rights to clients, then this doctrinal feature will be of little or no concern; on the contrary, the rule will be well tailored to the parties contractual intentions.

property rules as a means for protecting entitlements. If a court denies trade secret protection, then the employee may freely use the disputed knowledge to compete with his erstwhile employer. On the other hand, if a court finds the asset to constitute a protectible trade secret, the employer may exclude the employee completely. Injunctive relief is far and away the most typical remedy in both trade secret and restrictive covenant litigation. Accordingly, it is both permissible and commonplace for courts to award both injunctive relief (prospectively) and a gains-based accounting in damages (retrospectively) for profits wrongfully received due to the misappropriation.<sup>48</sup> While this appears, on first blush, to be a mixed regime of property and liability rules, the breadth and severity of retrospective remedies available seem clearly intended to deter any future misappropriations. Indeed, in addition to recovery for unjust enrichment, a successful plaintiff may also collect various other remedies, including compensation for losses actually caused by the appropriation, punitive damages, and (in some cases) attorney’s fees.<sup>49</sup> It has been said that the wide variety of situations that may develop in trade secret litigation require courts to be flexible and imaginative in devising remedies in damages.<sup>50</sup> If this be the case, then courts have succeeded admirably.

The existing preference for property rules seems motivated—at least in large part—by a self-conscious awareness among judges of the evidentiary problems manifest in attempting to compute damages accurately. Indeed, in the vast majority of cases, courts have been sympathetic to plaintiffs’ claims that damages are simply inadequate to remedy the loss of a trade secret.<sup>51</sup> The usual argument is that the loss of the trade secret will effectively let the “cat out of the bag,” causing the loss of prospective profits. In such situations, it may be extremely difficult to determine a remedy, both in terms of deciding an appropriate theory(ies) of damages (e.g., gains-based, loss-based, punitive), and in terms of computing the sum implied by this theory with reasonable certainty.<sup>52</sup> But

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<sup>48</sup>See generally, Jager, §§7.01. The UTSA §2, entitled “Injunctive Relief,” provides that “[a]ctual or threatened misappropriation may be enjoined. Upon application to the court, an injunction shall be terminated when the trade secret has ceased to exist, but the injunction may be continued for an additional reasonable period of time in order to eliminate commercial advantage that otherwise would be derived from the misappropriation.”

<sup>49</sup>The UTSA §3 makes clear that in addition to or in lieu of injunctive relief, the injured party may seek damages for actual loss caused by misappropriation, as well as unjust enrichment that is not taken into account in calculating damages. Where misappropriation is willful and malicious, the court may order exemplary damages of up to double the amount of the total monetary award. Attorney’s fees may be available if a claim on either side is made in bad faith, or if misappropriation is willful or malicious (§4).

<sup>50</sup>Jager, §7.03[2][a], citing *University Computing Co. v. Lykes-Youngstown Corp.*, 504 F. 2d 518, 538 (15th Cir. 1974). Thus although damages may be based in tort or contract, courts have sometimes blurred the conceptual distinctions between them, for example permitting damages in a breach of contract action based on the gain to the employee, rather than the loss of expected value to the employer. Prandl, (1987).

<sup>51</sup>Casagrande (2000), at 124 (noting that many cases reflexively recite that theft of a trade secret automatically inflicts irreparable harm, thus triggering injunctive remedies).

<sup>52</sup>Pranle (1987), at 448.

The relationship between verifiability and property rules is perhaps most salient in cases of customer lists. Whether an employee can be enjoined from soliciting the customers of her



whatever the motivation, the preference for property rules (when practicable) is now a veritable axiom of trade secret law. As the Supreme Court articulated in *Ruckelshaus v. Monsanto Co.*<sup>53</sup>:

The right to exclude others is generally ‘one of the most essential sticks in the bundle of rights that are commonly characterized as property.’ (citation omitted). With respect to a trade secret, the right to exclude others is central to the very definition of the property interest. Once the data that constitute a trade secret are disclosed to others, or others are allowed to use that data, the holder of the trade secret has lost his property interest in the data.”<sup>54</sup>

As noted above, for restrictive covenants, injunction is also by far the most common method of enforcement.<sup>55</sup> Here, too, the difficulty of reliably measuring damages often militates in favor of equitable remedies.<sup>56</sup> Occasionally, however, a restrictive covenant may be enforceable through liquidated damages. One commentator recently noted, for example, that including a liquidated damages clause in a restrictive covenant may make it easier to enforce.<sup>57</sup> The existence of a liquidated damages clause, however, does not serve as a bar to simultaneous injunctive relief if an injunction is enforceable on its own terms (i.e., deemed necessary to prevent irreparable harm<sup>58</sup>).

Although this has been a necessarily brief summary of trade secret law, we conclude by underscoring a number of important observations about existing doctrine. First, trade secret status frequently attaches to informational assets whose value is enhanced by sustained, long-standing investments of either employers or employees (or both). Second, the relative importance of the employee

former employer turns on the usual equitable principles of injunction, which ask *whether the harm to the plaintiff would be irreparable in the absence of an injunction, and whether the remedy at law is inadequate*. Jager, §7.01 (emphasis added). These criteria are frequently satisfied in cases, described earlier, in which no trade secret is involved, and yet the actions of the former employee are deemed to be a breach of confidence and unfair competition. *Id.* (Cite cases).

<sup>53</sup>467 U.S. 986 (1984).

<sup>54</sup>*Id.*, at 1101 (cited in Jager, §7.02.)

<sup>55</sup>S. Williston, *A Treatise on the Law of Contracts* (X ed., 19 —) §1446; Note, *Economic and Critical Analysis of the Law of Covenants Not to Compete*, 72 *Geo. L. J.* 1425, 1428 (1984) [hereinafter *Critical Analysis*] (the great majority of actions for breach of covenant not to compete seek injunction relief); *O’Sullivan v. Conrad*, 358 N.E. 2d 926, 929-30 (Ill. App. 1976) (once there is a breach of covenant, injunctive relief follows almost as a matter of course).

<sup>56</sup>Note, *Critical Analysis*, *id.*, at 1432-33.

<sup>57</sup>Paul R. Kitch, *Employee Noncompete and Nondisclosure Restrictive Covenants*, 88 *Ill. B. J.* 230, 232 (2000) (citing *Torrence v. Hewitt Assoc.*, 493 N.E. 2d 74 (Ill. App. 1986), in which the court noted when enforcing a liquidated damages clause in a restrictive covenant that the absence of an injunction meant that there was no impairment of the employee’s right to work and thus no injury to the public interest).

<sup>58</sup>See, e.g., *SSA Foods, Inc. v. Giannotti*, 434 N.E. 2d 460, 463 (Ill. App. 19—) (citing —). It should be noted, however, that some courts view the availability of a negotiated liquidated damages term as a signal from the parties that capitalizes the expected harm from an appropriation. See [cite]. Under such an interpretation, then, a liquidated damages provision would likely disable a plaintiff from obtaining injunctive relief.

in building up such assets tends to play little or no role in awarding protection to employers. Third, many jurisdictions allow parties to augment the protection afforded the employer through express covenants not to compete. Fourth, the most favored forms of entitlement protection in trade secret law consist of undivided property rules rather than divided entitlements, such as “fractional” ownership or liability rules.<sup>59</sup> And finally, even in those cases where damages are assessed, courts frequently face significant obstacles in verifying either the plaintiff’s loss or the defendant’s gain. As noted in the introduction, we are somewhat dubious (if not critical) of the current state of affairs. We present the principal reasons for our misgivings below.

### 3 A Model of Mutual Investment in Goodwill

This section presents our central arguments more formally, analyzing the relationship between goodwill-enhancing investments and trade secret entitlements through the lens of a one-period game theoretic model of contracting. Though relatively simple, such a framework exposes many of our core intuitions and facilitates demonstration of three of our principal arguments. First, we argue (consistent with existing literature on team production) that when the value of trade secrets truly depends on joint investments by employer and employee, it is generally impossible for any contract and/or legal rule to implement the optimal levels of investment. As such, the best a contract (or default legal rule) can do is to implement a form of second best that is compatible with the parties’ incentives and courts’ administrative limitations. Operating within such constraints, we show that an “optimal” trade secret law would (unlike existing doctrine) take express account of the relative contributions of the employer and employee in engendering consumer goodwill. We also demonstrate that in many circumstances, an optimal doctrine would tend to favor fractional entitlements or liability rules rather than the hard-and-fast property rules that trade secret doctrine (inter alia) currently prefers. Such entitlement schemes purposely envision a form of imperfect deterrence, in which employees successfully appropriate the firm’s trade secrets, at least in certain circumstances. Finally, we demonstrate a form of duality between fractional entitlements and liability rules, in which either type of entitlement protection (along with hybrid combinations thereof) is capable of implementing an optimal entitlement scheme.

#### 3.1 Basic Framework

Consider a contractual environment consisting of two risk-neutral players: An employee (“he”), denoted by  $A$ ; and an employer (“she”), denoted by  $B$ . Each player has a hand in operating a business venture (or “firm”), which operates in

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<sup>59</sup>By ‘fractional,’ we mean a type of property protection in which the underlying informational asset is explicitly shared among the parties. Examples might include geographic market divisions, divisions in time, or even probabilistic divisions of who receives the ultimate property right. See generally Ayres & Talley (1995).

a monopolistically competitive market (described at greater length below), and which lasts—at least for the purposes of this section—a single period. During the pendency of this period,  $B$  employs  $A$  to conduct routine tasks of production, but in addition  $A$  and  $B$  also have individual opportunities to take actions that increase prospective consumer “goodwill.” Such enhancements are important for the firm, because without them it must operate in a perfectly competitive market, making zero economic profits. Thus, the prospect of nurturing goodwill is what allows the firm (and thus,  $A$  and  $B$  collectively) to make a non-zero payoff, which we denote by  $v \geq 0$ . For expositional simplicity, we shall treat  $v$  as a direct proxy for the value of accumulated “goodwill.”<sup>60</sup>

To avoid unnecessary notation, we also suppress in what follows the precise details of the market mechanism that generates  $v$ , though we conjecture it to be somewhat generalizable (not unlike the very definition of “goodwill”). Indeed,  $v$  could emerge from any number of standard market contexts without affecting our ultimate conclusions. Examples include the following:

- Most simply,  $v$  might capture the *net willingness to pay*<sup>61</sup> of a single, brand-loyal customer who purchases one unit of output. Under this interpretation, the consumer herself constitutes the relevant demand-side market, and expenditures in goodwill are tantamount to investments that enhance her willingness to pay. (Because this is the simplest case, the ensuing analysis adopts a narrative that is most consistent with the single-customer account).
- Alternatively,  $v$  might represent the total size of a market consisting of a continuum of brand-loyal consumers, each of whom exhibits a net willingness to pay of some fixed infinitesimal value  $dv$ , so that the market’s aggregate net willingness to pay is equal to  $\int_0^v dv = v$ . Viewed in this sense, expenditures in “goodwill” are tantamount to investments that increase the *number* of loyal customers, rather than the net willingness to pay of each one.
- Finally, one could view  $v$  as a measure of total rents available in a market consisting of a continuum of consumers with differential loyalties. For instance, one might suppose that the firm charges a single price and faces a brand-specific inverse demand curve given by  $p(q) = c + \text{Max}\{0, A(v) - q\}$ , where  $c$  denotes the firm’s (constant) marginal cost,  $q$  denotes the firm’s output, and  $A(v) \equiv 2\sqrt{v}$ . The firm’s profit maximizing output in such an environment is given by  $q^* = \sqrt{v}$ , and its total economic profits are equal to  $v$ . Viewed in this sense, expenditures in goodwill are tantamount

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<sup>60</sup>Implicitly, then, this use is isomorphic to an assumption that the firm captures the entire value of the goodwill enhancements, if any, once they are realized. As noted, however, this assumption is simply for exposition, and is easily relaxed without loss of generality, so long as the parties are able to capture *some* fraction of the surplus created by investments in goodwill.

<sup>61</sup>By “net” willingness to pay, we mean her total willingness to pay less the competitive market price (or alternatively, less the firm’s constant marginal cost,  $c$ ).

to investments that increase *both* the number of loyal customers *and* the net willingness to pay of each.<sup>62</sup>

Notwithstanding which motivating account one adopts, the prospect of increasing  $v$  is clearly a critical consideration from an efficiency perspective, which we shall equate to the contractual objective of maximizing of the players' expected joint payoff.<sup>63</sup> Thus, it is important to be clear about how exactly the players might act to enhance goodwill. To this end, we assume in what follows that the realized value of  $v$  depends (stochastically) on non-monetary investments of effort by both the employee and employer, which we denote as  $a$  and  $b$ , respectively. In particular, suppose that  $v$  is a realization of a random variable  $V$ , drawn from an exponential distribution with (inverse) hazard rate of  $[\theta \cdot a + (1 - \theta) \cdot b]$ , where  $\theta \in (0, 1)$  is an exogenous parameter (discussed in greater length below).<sup>64</sup>

While we suspect that a number of alternative distributional assumptions are possible without changing our results, the characteristics of the posited distribution lend both tractability and consistency with our the principal intuitions about two-sided investments in goodwill. Indeed, within this framework, greater investment by either player (or, both) enhances the likely realization of the consumer's net valuation. A few sample probability density functions may help clarify this intuition. Figure 1 depicts two such functions (denoted as  $f(v)$ ) for different effort levels by the players. (In the figure, the value of  $\theta$  is fixed at  $\frac{1}{2}$ ). The solid line represents a situation where  $a = b = 1$ , while the dashed line represents the case where the parties have increased their investment to  $a = b = 3$ . As  $a$  and  $b$  increase, the density of  $V$  grows flatter, shedding probability mass from lower realizations, and adding mass to the right tail. This feature is consistent with our intuition that as the parties' respective investments grow larger, the likely realization of  $v$  tends to grow as well.<sup>65</sup>

<sup>62</sup>Similarly, if the firm were a perfect price discriminator against its loyal customer base,  $v$  would still capture the total rents available in the market if  $A(v) = \sqrt{2}v$ .

<sup>63</sup>Importantly, the aim of maximizing  $A$ 's and  $B$ 's joint welfare is not the only possible aim. For instance, in the third motivating account of  $v$  described in the text above, society may also care about the deadweight loss caused by the firm's monopoly pricing decision — a concern that is not reflected in  $A$ 's and  $B$ 's joint wealth. In most of what follows, however, we do not dwell on such considerations, for three reasons: First, such concerns may well be the province of antitrust law rather than trade secret law; second, the joint value maximizing contract is an important consideration for anyone interested in third-party effects; and finally, goodwill-enhancing investments are not particularly susceptible to meaningful welfare analyses in terms of consumer surplus. See, e.g. Tirole [1990], at 103.

<sup>64</sup>For a random variable  $X$  distributed according to an exponential distribution, the density function is given by  $f(x) = \frac{e^{-\frac{x}{\gamma}}}{\gamma}$ , and the associated c.d.f. is given by  $F(x) = 1 - e^{-\frac{x}{\gamma}}$ , where  $\gamma > 0$  represents the sole distributional parameter. The hazard rate for such a distribution is given by  $\frac{f(x)}{1-F(x)} = \frac{1}{\gamma}$ . Thus, for the distribution given in the text, the hazard rate is equal to  $\frac{1}{\theta a + (1-\theta)b}$ .

<sup>65</sup>The alert reader will notice that our framework implicitly considers investments in  $a$  and  $b$  to be neither technological complements nor substitutes. In other words  $\frac{\partial^2 E(V)}{\partial a \partial b} = 0$  for all  $a, b$ . Virtually all of our qualitative results persist, however, so long as both parties' investments truly matter — i.e., the parties efforts are less than perfect substitutes for one

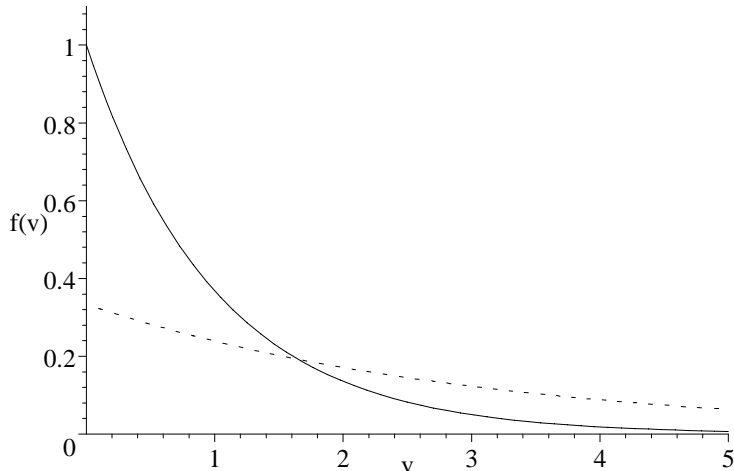


Figure 1

Note that the above framework allows for the players to have distinct skills at enhancing goodwill. Indeed, the parameter  $\theta$  captures the importance of the employee’s investment (relative to that of the employer) in enhancing consumer goodwill. When  $\theta = 0$ , the employer is the only party whose investment affects  $V$ . Conversely, when  $\theta = 1$ , only the employee’s investments matter. In the analysis that follows, however, we concentrate on the most interesting case of where  $\theta$  takes on more moderate values, and thus both the employee’s and employer’s investments are capable of enhancing consumer goodwill. For it is here that our model truly becomes one of “team production,” and it is here that we would be most likely to observe multi-person firms in practice.<sup>66</sup> Explicitly, then, we shall assume in what follows that there exists some  $\underline{\theta} \in (0, \frac{1}{2})$  such that  $\theta \in [\underline{\theta}, 1 - \underline{\theta}]$ .<sup>67</sup> At this point, it is helpful to take explicit note of the ratio  $(\frac{\theta}{1-\theta})$ , which represents the employee’s *relative marginal skill* at nurturing goodwill. (This expression will reappear in much of our analysis below).

Because the expected realization of  $v$  is strictly increasing in effort levels  $a$  and  $b$ , both players would prefer — all else held constant — large expenditures of effort by both parties. Of course, all else never is held constant. In this case, goodwill investments come at a cost to those who build it up. Explicitly, the players’ respective costs of expending effort are given by  $c_A(a) = \frac{1}{2}a^2$  and another.

<sup>66</sup>Indeed, when  $\theta = 0$  the employer would do just as well to higher a low-skilled employee for whom such goodwill enhancing investments are expensive. Conversely, when  $\theta = 1$ , the employee would do just as well (were he sufficiently liquid) to purchase the business from the employer.

<sup>67</sup>The fact that the interval is symmetric around  $\frac{1}{2}$  is relatively innocuous and can easily be relaxed at the cost of additional notation. Indeed, with some minor modifications, it would be possible (though not necessarily helpful) to apply the framework below for any subinterval on  $[0, 1]$ .

$c_B(b) = \frac{1}{2}b^2$ . Recall that, because these costs are non-monetary, they must be borne personally by the player expending them.<sup>68</sup>

Although the above framework adequately specifies the process by which parties can create and capture goodwill *as a single firm*, we have said little thus far about how the parties might divide that goodwill in the event that they find themselves in competition with one another. This is obviously an important consideration; for many a trade secret dispute involves situations where a departing employee uses customer information (or an analogous informational asset) to “compete” with his erstwhile employer once goodwill investments are sunk. One would hardly expect such a move to go uncontested by the employer, who is likely to attempt to retain its installed goodwill in spite of the employee’s efforts. In the face of the employer’s resistance, then, one would expect the employee’s maneuvering to prove successful only some of the time.<sup>69</sup> To capture this notion, we shall assume that should the employee attempt to appropriate customer goodwill, he will be successful only with some exogenous probability  $\sigma \in [0, 1]$ .

In addition, the aforementioned competition between the former employee and employer may frequently motivate them to offer enticements to lure or retain their customer base (as the case may be) — actions which ultimately dissipate the total rents available. Adding to this is the possibility that competition between  $A$  and  $B$  may induce them inadvertently to divulge the content of the trade secret to third parties who pose competitive threats. To reflect these dissipative considerations, we suppose that the ultimate winner of the contest between  $A$  and  $B$  captures only some (exogenous) fraction  $\kappa \in [0, 1]$  of the available surplus, and thus competition reduces the joint rents available to the parties from  $v$  to  $\kappa \cdot v$ .

Like  $v$ , the parameters  $\kappa$  and  $\sigma$  are relatively general, and admit at least two non-exclusive interpretations:

- From a market structure perspective,  $\kappa$  can be seen as reflecting the severity of market competition between  $A$  and  $B$  (along with any other potential competitors). “Cut-throat” (e.g., Bertrand) competition corresponds to a value of  $\kappa = 0$ , where subsequent competition dissipates all the available rents. Conversely,  $\kappa = 1$  reflects an extremely non-competitive environment, in which neither  $A$  nor  $B$  needs to offer price concessions to the customer. Intermediate values of  $\kappa$  reflect moderate degrees of competition (e.g., Cournot or Stackelberg). Similarly, under this interpretation,  $\sigma$  and  $(1 - \sigma)$  capture  $A$ ’s and  $B$ ’s resulting market shares of a resulting duopoly, and hence proxy for considerations such as first-mover advantages or preferences of the consumer(s) now having to choose between two

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<sup>68</sup>The quadratic form of the cost functions is actually more restrictive than necessary. All of our results will continue to hold for any cost functions  $c_i(x)$ ,  $i = \{A, B\}$  that are continuous, twice differentiable, increasing and convex for all  $x > 0$ , so long as  $c'_i(0) < \theta_0$ .

<sup>69</sup>See, e.g., *Bancroft-Whitney v. Glen* [cite], where the departing employees were able to siphon off a fraction of the business from the erstwhile employer’s customer list, but not all. For those who favor pop culture to case law, see *Jerry MacGuire, Act — Scene —* (TriStar Pictures, 1996).

(otherwise competitive) goods.<sup>70</sup>

- From a Coasean perspective,  $\kappa$  captures a measure of the transaction costs (and/or commitment problems) that impede ex post collusion between the parties. Particularly when post-employment competition is severe (see above), there is a strong incentive for  $A$  and  $B$  to bargain with one another, in order both to divide the market and to keep the contents of the trade secret confidential. Thus,  $\kappa = 1$  might represent a zero-transaction-costs world, in which—regardless of the default form of competition— $A$  and  $B$  are always able to collude and thus avoid leaving money on the table.<sup>71</sup> Lower values of  $\kappa$  are consistent with the presence of positive transaction costs that tend to impede such collusion. Viewed from this perspective, then,  $\sigma$  would capture  $A$ 's ex post bargaining power against  $B$  in deciding who how to divide the market. Values of  $\sigma$  close to 1 are consistent with significant employee bargaining power, and vice versa when  $\sigma$  is close to 0.

Before proceeding, it is convenient at this juncture to define a few terms frequently associated with our methodology and to state an assumption pertaining thereto. First, in the analysis that follows, we shall take care to check that the parties' investment and post-investment strategies constitute a Bayesian-perfect equilibrium. In other words, we shall require that at each juncture of the game, each of the parties acts in a way that is a strategic best response to the posited strategy of the other party. When, under a given contract, such a condition holds true for both parties, their posited actions are said to be *incentive compatible*.

Second, we shall also take care to be sure that given their expectations about later equilibrium play, each of the players has an incentive to participate in the contract to begin with. Equivalently, we shall always require that each of the players must expect to receive at least her opportunity cost in exchange for participation. For the employer, this means receiving an expected payoff that exceeds her fixed costs associated with running the business, denoted by  $F \geq 0$ . For the employee, it means receiving an expected payoff at least as large as the wage that he could presumably earn from an outside entity, denoted by  $\bar{w} \geq 0$ . When both of these conditions are met under a candidate contract, the contract is said to be *individually rational*.

The analysis which follows becomes significantly less tedious if we assume that a condition related to — but weaker than — individual rationality is always satisfied. In particular, we shall assume throughout what follows that the minimal attainable operating profits at the firm are not “too” low. Mathematically, this assumption is as follows:

**Assumption 1:**  $F + \bar{w} \leq \frac{1}{2} \cdot \underline{\theta}^2$ .

<sup>70</sup>For the sake of generality, we allow  $\sigma$  to be independent of the investment parameter  $\theta$ , though one could certainly imagine situations where the customer is more likely to go with the entity who was most successful at enhancing her goodwill.

<sup>71</sup>That is, transferring rents to consumers.

Assumption 1 essentially requires that there are always positive net gains from organizing and operating the firm. It is a necessary (but not sufficient) condition for individual rationality. The left hand side of the inequality represents  $A$ 's and  $B$ 's aggregate opportunity costs from working at the firm. The right hand side of the inequality represents the gross payoff that the firm would be able to generate under the stewardship of the most inept type of employer (i.e.,  $\theta = \underline{\theta}$ ) who enjoys an undivided property right in the value of goodwill.<sup>72</sup>

Finally, and nontrivially, the analysis that follows assumes that employee's total wealth is constrained at some level  $Y < \infty$ , so that the most draconian payoff that could ever be visited upon him is equal to  $-Y$ . This limited ability to post a performance bond is potentially an important consideration, particularly for contracts under which the employee would receive most of the available downstream rents. For definitional purposes, we shall say in what follows that a given contractual allocation is *implementable* if it is incentive compatible, individually rational and also satisfies  $A$ 's wealth constraint.<sup>73</sup>

### 3.2 First Best

For purposes of comparison, we first ask what levels of investment maximize the sum of the player's expected payoff (i.e., joint welfare), net of their respective opportunity costs. As we shall soon discover, informational constraints may render such an outcome it unattainable. Nevertheless, establishing a first best measure of investment will prove a useful benchmark for the sake of later comparisons.

Note first that whenever  $\kappa < 1$ , it is never part of a first-best allocation for the employee to compete with the employer. Indeed, if he did so, it would reduce the total available surplus to  $\kappa \cdot v < v$ , thereby squandering a  $(1 - \kappa)$  fraction of the available surplus. Thus, unless  $\kappa = 1$ , a first best allocation will always suppress potential competition between  $A$  and  $B$ .<sup>74</sup>

Assuming, then, that none of the allocational surplus is squandered, the first-best investment levels are given by solving the following problem:

$$\text{Max}_{a,b} \left[ E(V|a,b) - \frac{a^2}{2} - \frac{b^2}{2} \right] \quad (1)$$

Noting that  $E(V|a,b) = \theta \cdot a + (1 - \theta) \cdot b$ , this yields first best effort levels:

$$a^{fb} = \theta; \quad b^{fb} = (1 - \theta)$$

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<sup>72</sup>Relaxing Assumption 1 is eminently possible, once again at the cost of additional notation. However, if anything, doing so probably *strengthens* our argument that pro-employer property rights are frequently inferior to other entitlement regimes. Indeed, assuming that both  $F$  and  $\bar{w}$  are necessary fixed costs of production, violation of Assumption 1 would imply that an incentive compatible, individually rational contract under a pro-employer property entitlement is simply unattainable.

<sup>73</sup>Following convention (and intuition), we shall assume throughout that the employer does not face a wealth constraint that binds in any payoff-relevant circumstances.

<sup>74</sup>When  $\kappa = 1$ , obviously, such competition is irrelevant to allocational efficiency.



which in turn give rise to a maximized social welfare value<sup>75</sup> of  $\left[\frac{\theta^2 + (1-\theta)^2}{2}\right]$ .

Quite clearly, it would be most desirable to write a contract mandating that the respective parties invest  $a^{fb}$  and  $b^{fb}$ . However, enforcing such a contract would require a number of preconditions that (in our minds) are not generally present. Indeed, such a contract would require that the parties could observe (and provide probative evidence about) one another’s conduct, so as to deter deviations from the prescribed behavior. In many business contexts — and in particular those studied here, where the player’s “efforts” take place in rather disparate arenas — both observability and verifiability are likely impossible. In such situations, even when the customer’s realized valuation is commonly-known, this first-best level of investment is not attainable. This reasoning is embodied in the following proposition, whose proof is well-known in the literature<sup>76</sup>:

**Proposition 1:** *If  $a$  and  $b$  are not observable and verifiable, there does not exist an implementable contract that achieves a first best level of investment.*

This result is fairly easy to see. No matter how the various investments of the parties are split, they still must be split. And thus, on the margin at least one party must bear all the marginal costs of her investment, but will see only a fraction of the marginal gains. The obvious consequence is endemic underinvestment.

Absent contracting directly on  $a$  and  $b$ , then, the players might attempt to write a contract based on the realized value of  $v$ . Such a contract would give each of the parties some share in the realized surplus. It turns out that even here, absent involvement of a third party, even these forms of contracts are generally not able to achieve first-best efficiency, but may be able to accomplish some measure of second best.<sup>77</sup>

In the analysis that follows, however, we posit that the parties must operate in an even more constrained judicial environment yet. Indeed, as was noted in the introduction, one of the reasons that courts have favored property-like entitlements is that they face significant obstacles in measuring damages. As such, even when the realization of  $v$  is observable to both parties, often a court will not have the resources to verify their observations. In order to be sensitive to this possibility, we shall purposely assume in what follows that an optimal contract (and thus legal doctrine) can turn on neither the investments of the parties nor the realized value of the goodwill created. Rather, we shall assume that courts’ verification powers are limited to discerning (i) whether the employee is still working with the firm, and (ii) if he is not, whether he is attempting to appropriate the installed goodwill in order to compete with his erstwhile employer.<sup>78</sup>

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<sup>75</sup>Note, of course, this is a measure of gross social welfare. The “true” economic surplus can be obtained by subtracting the parties’ opportunity costs,  $\bar{w}$  and  $F$ . If Assumption 1 holds, this difference will always be strictly positive.

<sup>76</sup>See, e.g., Holmstrom (1982); Grossman & Hart (1986).

<sup>77</sup>See, e.g., Schwartz & Watson (2000); Che & Rauch (1999).

<sup>78</sup>There is another, more basic motivation behind our assumption that  $v$  is not verifiable in

### 3.3 Incentive Efficient Allocations

Given that first-best is probably not attainable, our inquiry now asks what is the best one can do in a second-best (“or incentive efficient”) world. As noted in the introduction, our analysis will (for the most part) equate optimal contracting with an optimal legal rule – that is, the most efficient legal rule would provide all the incentivizing aspects of the contract, and by so doing facilitate the execution of a very simple (flat wage) express contract. In the subsections that follows, we will compare three distinct types of legal entitlements from an optimal contracting perspective: Property Rules, Fractional Entitlements, and Liability Rules. As noted above, we shall suppose throughout that the realized value of goodwill,  $v$ , is observable but not verifiable in court.

#### 3.3.1 Property Rules

Consider first the choice among two “undivided” property rules: One favoring the employer (and thus prohibiting all attempted appropriations) and the other favoring the employee (and thus allowing unfettered competition between the employer and employee should the latter leave the firm). To be sure, this is perhaps the most resource-constrained environment a judge may find herself in. All she can do is to choose who gets the entitlement, and then protect it with the threat of injunctive relief (or stiff, in *terrorem* penalties). Nevertheless, this is an important case to consider: as noted in the introduction, courts generally utilize property rules rather than liability rules to protect trade secrets, and thus most of the doctrinal puzzles revolve around who receives the assignment (rather than how her entitlement is protected).

Let  $q \in \{0, 1\}$  denote a policy variable distinguishing between a pro-employer property assignment ( $q = 0$ ) on the one hand, and a pro-employee entitlement — that is, an entitlement to compete freely — ( $q = 1$ ) on the other. Under a pro-employer property entitlement, only the employer receives any of the rents from development of goodwill. The employee, meanwhile, earns only his wage less the costs of his efforts. Under a pro-employee “property” rule, in contrast, the employer is not necessarily disabled from appropriating goodwill; rather, such a rule merely permits the employee an unfettered right to compete on even ground with the employer for the existing goodwill. Within such a regime, then, the employer may still wish to invest *ex ante*, knowing that she will be able to appropriate the fruits of that investment at least some of the time.

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court: If it were, it would be unlikely to observe either the contractual environment we posit, or many trade secret disputes. Indeed, observability of  $v$  permits the consideration of a range of contracts involving third-parties — contracts that can attain first-best levels of investment.

To see this point more clearly, suppose that  $A$  and  $B$  entered the following ‘swap’ contract with a third party,  $C$ :  $C$  receives an up-front payment of  $v^* = \left[ \frac{\theta^2 + (1-\theta)^2}{2} \right]$ , but in return she promises to pay the firm an amount equal to the realization of  $v$ , doubling the firm’s gross income to  $2v$ , which is then split by the players. So long the up-front payment does not violate  $A$ ’s wealth constraint, it always gives rise to first-best investment and no defections by the employee, even in the absence of trade secret protection.

Given the various parameters of the model explained above, one can derive the player's respective ex ante payoffs as a function of  $q$  as follows:

$$\pi_A(a, b) = w + (q \cdot \sigma \cdot \kappa) \cdot E(V|a, b) - \frac{a^2}{2} \quad (2)$$

$$\pi_B(a, b) = -w + [(1 - q) + (1 - \sigma) q \kappa] \cdot E(V|a, b) - \frac{b^2}{2} \quad (3)$$

The optimal contracting problem amounts to choosing effort levels  $a$  and  $b$ , a wage  $w$ , and a property entitlement  $q \in \{0, 1\}$  so as to maximize expected surplus, subject incentive constraints, participation constraints, and  $A$ 's wealth constraint. More formally, the problem is as follows:

$$\begin{aligned} \underset{a, b, w, q \in \{0, 1\}}{\text{Max}} \quad & \pi_A(a, b) + \pi_B(a, b), \quad \text{subject to :} \\ & \text{(i) } a \in \arg \max \pi_A(a, b) \\ & \text{(ii) } b \in \arg \max \pi_B(a, b) \\ & \text{(iii) } \pi_A(a, b) \geq \bar{w} \\ & \text{(iv) } \pi_B(a, b) \geq F \\ & \text{(v) } w \geq -Y \end{aligned}$$

In the above problem, constraints (i) and (ii) represent incentive constraints, which (recall) require the player's investments must constitute an equilibrium. Constraints (iii) and (iv) represent participation constraints, requiring that each player expect at least her reservation payoff from participating in the contract. And constraint (v) represents the employee's wealth constraint. Analysis of this problem yields the following proposition (whose proof can be found in the appendix):

**Proposition 2:** *Consider the binary choice among entitlements  $q \in \{0, 1\}$ . The optimal entitlement,  $q^*$ , is given by:*

$$q^* = \begin{cases} 1 & \text{if } \frac{\theta}{1-\theta} \geq \hat{N} \text{ and } Y \geq \hat{Y} \\ 0 & \text{else} \end{cases},$$

$$\text{where } \hat{N} \equiv \left( \frac{\sigma^2 + \kappa^{-2} - 1}{\sigma \cdot (2 - \sigma)} \right)^{\frac{1}{2}} \text{ and } \hat{Y} \equiv F - \kappa^2 (1 - \sigma) \left( \sigma \theta^2 + \frac{(1 - \sigma)}{2} (1 - \theta)^2 \right).$$

Proposition 2 articulates necessary and sufficient conditions for a court to grant the employe an entitlement to compete (or equivalently, deny trade secret protection to an employer). Such an outcome is optimal if and only if (i) the employee's skill at engendering goodwill (relative to the employer's) is sufficiently high; and (ii) his wealth constraint is not binding. If either of these conditions fails, a property right in the trade secret favoring the employer is optimal. Clearly, then, a few words about both conditions are in order, and we discuss them in turn.

(i)  $\frac{\theta}{1-\theta} \geq \hat{N}$ . This condition states that the optimal entitlement depends on an assessment of the relative advantage that the employee has over the employer in enhancing consumer goodwill. Note that so long as  $\kappa$  and  $\sigma$  are positive,  $\hat{N}$  is bounded away from both 0 and  $\infty$ . Moreover, whether  $\hat{N}$  exceeds or is less than one is indeterminate, and will depend on the values of the deep parameters of the model.<sup>79</sup> Thus, for any fixed value of  $\hat{N}$ , it is always the case that an employee with sufficiently large skills at enhancing goodwill should receive the entitlement. From a doctrinal perspective, the fact that the optimal property rule turns on relative advantage is significant: As noted in the last section, many courts tend to stop at the conclusion that employer investments played *any* role in enhancing goodwill, upon which they assign the right to the employer.

This result is consistent with that of Aghion & Tirole (1994), but it adds to it in two respects. First, Aghion and Tirole study the binary choice between (i) assigning an exclusive property right to the employer, versus (ii) assigning the exclusive right to the employee. Importantly, this is rarely the comparison that one observes in practice, where judges must choose between assigning ownership to the employer or assigning it to no one. Our analysis, in contrast, tracks the more conventional legal decision: An assignment of  $q = 1$  simply allows both the employer and employee to compete freely for the installed goodwill. Second, and relatedly, the parameters that affect the parties' payoffs from that competition matter. As is clear from the proposition, the values of  $\kappa$  and  $\sigma$  are critical in determining the benchmark  $\hat{N}$ .<sup>80</sup> On inspection it is clear that  $\hat{N}$  is strictly decreasing in  $\kappa$ , signifying that when competition between  $A$  and  $B$  grows increasingly destructive of their joint rents, an optimal doctrine will accordingly demand a larger comparative advantage of the employee before awarding her the entitlement. This tendency is consistent with one's intuitions.

On the other hand, the relationship between  $\hat{N}$  and the employee's ability to lure customers from the employer,  $\sigma$ , is not a monotone one. Nonetheless, one can still make a few generalizations. When competition between  $A$  and  $B$  is not destructive ( $\kappa$  is near one), the threshold value of  $\hat{N}$  is increasing in  $\sigma$ , and thus  $A$ 's effectiveness at siphoning off business (and/or bargaining power) actually works against her.<sup>81</sup> The intuition behind this observation stems from recognizing one that one of the principal values of non-protection (at least when  $\sigma < 1$ ) is that it still induces both parties to invest: Indeed, *even the employer* thinks there is a chance she can retain her customer base in the face of the employee's competitive challenge. When  $\sigma$  grows large, the employer loses this incentive; and thus the threshold at which the employee's relative advantage justifies awarding her the property right grows accordingly. Conversely, when competition between  $A$  and  $B$  is highly destructive ( $\kappa$  is near zero), the threshold  $\hat{N}$  decreases in  $\sigma$ , thereby imposing a lesser burden on  $A$  to demonstrate his

<sup>79</sup>It can be shown, however, that  $\kappa \leq \sqrt{\frac{2}{3}}$ , then  $\hat{N} \geq 1$  no matter what the value of  $\sigma$ .

<sup>80</sup>Note that the special case of  $\kappa = \sigma = 1$  is equivalent to the Aghion/Tirole framework, where  $q = 1$  implies that the employee always receives an undivided entitlement.

<sup>81</sup>In particular, the sign of  $\frac{\partial \hat{N}}{\partial \sigma}$  has the same sign as does  $\kappa^2(\sigma + 1 - \sigma) - (1 - \sigma)$ .

relative advantage. Here the intuition less direct, but similar: When  $\sigma$  is small, the employee is not confident ex ante of his abilities to appropriate any customer goodwill, and he is made even more pessimistic by the fact that  $\kappa$  is small, and thus even attempting to appropriate will dissipate a number of the available rents. Since the first few dollars of the employee's investment come cheaply, it becomes optimal to ease back on  $\hat{N}$  thereby giving at least some employees an incentive to invest notwithstanding prospective joint losses due to competition.

(ii)  $Y \geq \hat{Y}$ . The second condition stated by Proposition 2 is that in some situations, a pro-employee entitlement may entail requiring that he be sufficiently liquid to compensate  $B$  ex ante for her expected shortfalls. In essence, this condition states that if, under a pro-employee assignment,  $B$ 's expected variable profits<sup>82</sup> fail to cover her fixed costs, then  $A$  would have agree to a *negative* wage sufficiently large to make up the difference. If he is severely wealth constrained, he may not be able to afford such a transfer payment, even if he agreed to pay his entire disposable wealth,  $Y$ . In such a situation, a property entitlement favoring  $A$  is not feasible.

A few things bear noting about the condition on  $Y$ . First, note that it is only one of two conditions at play. Many principal-agent models hinge critically on the agent's wealth constraint. That is, all inefficiencies could be removed by simply selling the business to the employee, or having him post a sufficiently large performance bond. In the case of two-sided investment, however, wealth constraints are merely one consideration (which need not bind). Second, note the constraint on the employee's available wealth becomes sharper as  $\kappa$  decreases, and as  $\theta$  and  $\sigma$  increase. This is consistent with one's intuition. As competition becomes more destructive of available rents ( $\kappa$  shrinks) or as the employee becomes a more effective competitor ( $\sigma$  grows),  $B$  has a reduced chance of recouping her fixed costs through competition, and will require a larger up-front concession from  $A$ .

On the other hand, as these two parameters move in the opposite direction, the wealth constraint on the employee may become so slack as to require no up-front bonding by the employee. In addition, note that if the employee's wealth is at least as large as the employer's fixed costs, then condition (ii) will always be satisfied. While it may be unrealistic to think in the ordinary course that an employee has such resources, one has to remember that in the context of trade secrets, one is often dealing with highly-skilled (and thus highly-remunerated) employees. In many circumstances the employee will have such resources available.

Be that as it may, the take-away message from this subsection can be summarized as follows. If courts *must* choose among undivided property entitlements, then an optimal legal entitlement will not generally turn (as does current doctrine) on a simple assessment of whether employer investments in enhancing goodwill are/have been important, or merely whether a valuable trade secret exists. Instead, courts should take into consideration *relative* abilities of the

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<sup>82</sup>That is,  $(1 - \sigma) \cdot \kappa \cdot E(v) - \frac{(b^*)^2}{2}$ .

employee and employer to make such investments. Moreover, there is no a priori reason to favor employers in making this assessment. Indeed, the *employee* may be the most efficient ex ante entitlement holder when:<sup>83</sup>

- The employee enjoys a comparative advantage in building up goodwill (i.e.,  $\frac{\theta}{1-\theta}$  is large);
- Post-termination competition between employer and employee is not too destructive and/or inter se transaction costs are small (i.e.,  $\kappa$  is large);
- The employer either is partially effective at retaining existing customers in the face of competition with the employee and/or she has a large amount of ex post bargaining power (i.e.,  $\sigma$  is small); and
- The wealth constraints on the employee are not severe (i.e.,  $Y$  is large).

### 3.3.2 Fractional Entitlements

The analysis thus far has concentrated solely on a binary choice among undivided property rules. As noted in the previous sections, this choice appears to be what most courts tend to focus on. However, suppose that instead of declaring ex ante whether the employer gets the entitlement, a court (credibly) commits to a mechanism that assigns to each of the parties a *fractional* claim over the entitlement, through either a randomization process, or (if feasible) an explicit division of the market (such as granting trade secret protection to but a strict subset of existing customers). In this subsection, we briefly address such possibilities explicitly. While we find them to be a promising alternative, they may not ultimately be universally practical in a system that tends to evolve towards clear, ex ante rules, and away from ex-post standards. Nevertheless, such partial entitlement schemes still deserve our attention, at least some of the time.

Before commencing, we should take care to point out that certain types of partial entitlements will simply not be feasible if (as we have maintained)  $v$  is not verifiable in court. Thus, a court seeking to award a partial entitlement will not be directly able to divide the monetary income stream among the parties. However, it may be able to do so using indirect means. Suppose, for example, that a court did not determine an entitlement until after investments are made, upon which one of the parties petitions it to make a property rights assignment. (Such situations may be more plausible than one would ordinarily think, often taking the form of declaratory judgment actions by either the employee or employer against her counterpart). Moreover, suppose that when it is so called upon to act, the court randomizes its decision, awarding the employee the entitlement to compete with probability  $q$ , and the employer with probability  $(1 - q)$ . Once the court makes its decision,  $A$  may attempt to appropriate should it receive the assignment.

<sup>83</sup>It should be emphasized that this list is neither conjunctive nor alternative, but rather a collection of important factors. For instance, a strong case pro-employee advantage in productivity relaxes the requirement that  $\kappa$  must be relatively large.

Note that  $q = 1$  simply corresponds to a rule that always assigns the entitlement to the employee with certainty, and vice versa for  $q = 0$ . These two extreme cases were studied in the earlier section. For intermediate values of  $q$ , the parties' respective payoffs ( $\pi_A(a, b)$  and  $\pi_B(a, b)$ ) are identical to those defined in equations (2) and (3) from the previous subsection.

In a world of fractional entitlements, the employee's wealth constraint becomes somewhat more complex than in the previous subsection. In order to deal with this complexity, it is convenient to state the following lemma:<sup>84</sup>

**Lemma A:** *A fractional entitlement  $q$  is implementable only if the employee's wealth,  $Y$ , is at least  $Y(q)$ , where:*

$$Y(q) \equiv F - q\sigma\kappa((1-q) + q(1-\sigma)\kappa)\cdot\theta^2 + \frac{((1-q) + q(1-\sigma)\kappa)^2}{2}(1-\theta)^2.$$

The condition in the above lemma is simply a generalization of the wealth constraint condition from Proposition 2,<sup>85</sup> modified to reflect the differential effects that changes in  $q$  impose on the employee's wealth constraint. Intuitively, as  $q$  increases from 0, the employer's equilibrium revenue (i.e., her expected payoff gross of wages, fixed costs and direct effort costs) strictly decreases, as the employee receives a stronger fractional right to siphon off business. This steady decline will eventually put a significant strain on the employer's incentives to participate, which, recall, require that she earn net profits large enough to satisfy at least her fixed costs  $F$ . However, as the employer's equilibrium payoff decreases, the employee's increases, which makes her more likely to accept a low wage, and perhaps even a negative wage (in, say, the form of a performance bond). But in no event can such a bond exceed  $A$ 's disposable wealth,  $Y$ . Accordingly, the condition in the lemma comes from asking whether the employer would still be willing to participate in the event that such a bond were maximal — that is, set equal to the employee's disposable wealth. As the condition states, the employer willingness to participate would depend on  $q$ , — and in particular she would participate only if  $A$  could post a bond of at least  $Y(q)$ .<sup>86</sup>

Beyond these caveats, the optimal contracting problem is virtually identical to that of the previous subsection, and consists of choosing effort levels  $a$  and  $b$ , a wage  $w$ , and a property entitlement chosen from the interval  $q \in [0, 1]$  to maximize expected surplus subject incentive, participation, and wealth constraints:

$$\begin{aligned} \underset{a, b, w; q \in [0, 1]}{\text{Max}} \quad & \pi_A(a, b) + \pi_B(a, b), \quad \text{subject to :} \\ & \text{(i) } a \in \arg \max \pi_A(a, b) \\ & \text{(ii) } b \in \arg \max \pi_B(a, b) \\ & \text{(iii) } \pi_A(a, b) \geq \bar{w} \\ & \text{(iv) } \pi_B(a, b) \geq F \\ & \text{(v) } w \geq -Y \end{aligned}$$

<sup>84</sup>The proof of this lemma is omitted.

<sup>85</sup>That is, the condition  $Y \geq \hat{Y}$ . To see this, simply note that  $Y(1) = \hat{Y}$  as given in the Proposition.

<sup>86</sup>The reader should note that for high enough values of  $q$ ,  $Y(q)$  is negative, and thus it does not represent an important constraint. Indeed,  $Y(q)$  is never binding if  $Y > Y(1) = \hat{Y}$ .

Analysis of this problem yields Proposition 3 (whose proof can be found in the appendix):

**Proposition 3:** *Consider the choice among fractional entitlements  $q \in [0, 1]$ . The optimal entitlement,  $q^*$ , is given by:*

$$q^* = \begin{cases} 0 & \text{if } \frac{\theta}{1-\theta} < N_0 \\ 1 & \text{if } \frac{\theta}{1-\theta} > N_1 \text{ and } Y \geq Y(1) \\ q_{\kappa\sigma} & \text{if } \frac{\theta}{1-\theta} \in [N_0, N_1] \text{ and } Y \geq Y(q_{\kappa\sigma}) \\ \hat{q}_{\kappa\sigma} & \text{else} \end{cases}, \text{ where}$$

$$N_0 \equiv \left(\frac{\kappa^{-1}-1}{\sigma}\right)^{\frac{1}{2}}; \quad N_1 \equiv \begin{cases} \left(\frac{\sigma^2+\kappa^{-1}-1}{\sigma \cdot (2-\sigma-\kappa^{-1})}\right)^{\frac{1}{2}} & \text{if } \kappa > \frac{1}{2-\sigma} \\ \infty & \text{else} \end{cases},$$

$$q_{\kappa\sigma} \equiv \frac{\left(\frac{1}{\sigma\kappa}\right) \cdot \left[\left(\frac{\theta}{1-\theta}\right)^2 - N_0\right]}{\left(1-N_0^2\right) + \left(\frac{\theta}{1-\theta}\right)^2 (1+2N_0)}, \quad \text{and}$$

$\hat{q}_{\kappa\sigma}$  is the unique root on  $[0, 1]$  of the equation  $Y = Y(q)$ .

In spite of its tedious notation, Proposition 3 is actually relatively simple. It states two principal arguments worth emphasizing. First, it suggests that when one opens up consideration to include fractional entitlements, the optimal entitlement scheme *still* boils down to comparing the parties' relative skills at enhancing consumer goodwill. When the comparative advantage sits one-sidedly with the employer, the optimal rule tends toward a pro-employer property rule, and vice versa when such an advantage resides with the employee. So far, this is very much like the bottom line message from Proposition 2. But Proposition 3 also states that a fractional entitlement scheme may frequently be preferable to either type of undivided property rule. The table below summarizes this observations. The columns of the table designate three relevant regions into which the employee's relative goodwill-enhancing skills might fall: Region 1 designates situations where the employer has a relatively one-sided relative advantage. Region 3 designates situations where the one-sided advantage sits with the employee; and Region 2 designates situations where the parties' skills are commensurable (relative to other parameters in the model). Note that within Region 2, fractional entitlements tend to be optimal.

	Region 1 $\frac{\theta}{1-\theta} < N_0$	Region 2 $N_0 \leq \frac{\theta}{1-\theta} \leq N_1$	Region 3 $\frac{\theta}{1-\theta} > N_1$
$Y(q)$ not binding	<i>Prop. Rule: B</i>	<i>Fractional</i>	<i>Prop. Rule: A</i>
$Y(q)$ binding	$N/A^{87}$	<i>Fractional</i>	<i>Fractional</i>

Table 1

<sup>87</sup>So long as Assumption 1 holds, the agent's wealth constraint will never bind with a pro-principal property rule.



Another interesting feature reflected in the table (and in Proposition 3) concerns the relationship between the optimal entitlement and the employee’s wealth constraint. This can be seen most clearly by considering the rows of the table, which reflect whether the constraint on the employee’s wealth ( $Y \leq Y(q)$ ) is binding on the contracting problem. Note from the table that, unlike with pure property rules (where significant wealth constraints always imply a pro-employer assignment), here a binding wealth constraint means *at most* (i) that an optimal entitlement assignment would not award  $A$  (i.e., the employee) an absolute right to compete, or (ii) that it should lean *slightly more* in the direction of the employer than it otherwise would absent such a constraint. However, in no instance does  $A$ ’s liquidity constraint *alone* imply that the employer should receive an absolute entitlement to accumulated goodwill.<sup>88</sup> This is a significant result, given the frequency with which legal scholars and economists have defended pro-employer property rights on the basis of an employee’s inability to bond.<sup>89</sup>

Consistent with the previous section, there is no a priori reason to think that “most” employment arrangements will fall in the Northwest cell of the above table. Indeed, contractual environments that are likely to fall outside Region 1 include those in which:

- The employee possesses even moderate skills at building up goodwill (i.e.,  $\frac{\theta}{1-\theta}$  is not too small);
- Post-termination competition between employer and employee is not too destructive and/or inter se transaction costs are small (i.e.,  $\kappa$  is large); and
- The employer either is partially effective at retaining existing customers in the face of competition with the employee and/or she has a large amount of ex post bargaining power (i.e.,  $\sigma$  is relatively small).

In spite of the advantages that fractional entitlements frequently enjoy over hard-and-fast property rules, we are not naïve about the potential practical problems in implementing such schemes. Although the current state of trade secret law may be notably unpredictable,<sup>90</sup> it is the very nature of the legal system to strive for clarity and certainty. Over time, standards and casuistry often give way (for better or for worse) to rules and rights.<sup>91</sup> The law of trade

<sup>88</sup>One caveat should be noted here: In situations where the employer has all of the *ex ante* bargaining power, the employee’s wealth constraint, if sufficiently sharp (at, say,  $Y = 0$ ) can imply the optimality of a pro-employer property right. See, e.g., Talley (1998). However, this concern is of little moment if either of these conditions is relaxed (even moderately). We suspect that such situations are probably more common in environments of highly skilled workers, whose unique skills give them both additional bargaining power and additional accumulated capital that slackens their wealth constraint.

<sup>89</sup>Cites.

<sup>90</sup>Hyde (2000), for instance, notes while the definition of ‘trade secret’ is broad enough to include almost any informational asset (and some non-informational ones), most cases actually turn on opaque, moralist comparisons that are subject to chronic indeterminacy.

<sup>91</sup>Cite Rose; Kaplow.

secrets may be no different in this regard. As such, there is no guarantee that the sort of sustained institutional “randomness” that would be necessary to implement a probabilistic entitlement protection will be long lived.<sup>92</sup>

In the absence of such probabilistic mechanisms, a court would have to find other ways to implement a fractional entitlement. One possibility would be for courts to attempt explicit divisions of the relevant market, say by enjoining the employee from competing for some given fraction of the firm’s customers, or by distorting the competitive environment by limiting the content of the communications that departing employees may transmit to prospective clients. Some of these alternative schemes may be effective for some firms (and indeed have been implemented by some courts<sup>93</sup>); but for other businesses — such as those with a small number of core, revenue-generating clients — it may be genuinely impossible (in the absence of probabilistic approaches) to implement these sorts of Solomonic divisions.

Nevertheless, we believe that the arguments made here are still important, for at least two reasons. First, although trade secret doctrine may eventually evolve to a perfectly predictable, rule-based doctrine, it still has a long road to travel. In its current state, trade secret law is still riddled with unpredictabilities that put the ultimate outcome of many a dispute in doubt. Rather than decrying this characteristic as a weakness and advocating hastened reform,<sup>94</sup> our analysis counsels a somewhat more measured response — one that highlights the hidden strategic benefits of preserving unpredictability as long as is practicable (at least in situations involving genuine two-sided investment). Second, our analysis suggests that courts should at least ponder the feasibility of trade secret doctrines that explicitly divide markets. Indeed, if an express division of markets can be accomplished, in many instances that would be preferable to a monolithic award of all the available rents to a single party.

In fact, as the next section suggests, there may be more than one way to skin a cat. For even when expressly fractional entitlements are impractical, it may well be possible to use liability rules to accomplish a similar result. It is to this consideration that we now turn.

### 3.3.3 Liability Rules

We have heretofore explicitly limited our attention to property entitlements, either undivided or fractional. But we haven’t said anything about another form of divided entitlement, liability rules. This subsection addresses this omis-

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<sup>92</sup>A possible exception here is the closely-related “corporate opportunities doctrine,” which seems to suffer from chronic unpredictability. See Talley (1998); Brudney & Clark (1981).

<sup>93</sup>Cites.

<sup>94</sup>See, e.g., Note, The Impending Merger of the Inevitable Disclosure Doctrine and Negative Trade Secrets: Is Trade Secrets Law Headed in the Right Direction?, 25 J. Corp. L. 383, 396 (2000); Uniform State Laws Comm., Or. State Bar, Brief History of UTSA in Oregon at P 1 (submitted as a portion of exhibit 6 to Public Hearing on SB 298 Before the Senate Judiciary Comm., 64th Leg. Assembly (Or. Apr. 1, 1987)), at P B. (concluding that then-existing Oregon trade secrets law was unpredictable in several respects and that properly drafted legislation could make the law more predictable and reconcile apparent conflicts in the law.

sion, and argues that liability rules may be an adequate substitute for express fractional entitlements.

Like before, we shall consider contracts containing a flat wage component, denoted by  $w$ . But unlike before, we shall assume throughout that a hard-and-fast entitlement is awarded to the employer. Instead, it is the form of protection that we shall vary. In particular, we assume below that in the event that the employee attempts to appropriate the firm's goodwill, he would not be impeded from so doing as long as he were willing to pay  $D \geq 0$  dollars to the employer in the form of damages. (Consistent with our assumption that  $v$  is not verifiable, the damages term  $D$  cannot depend on either the actual investments of the parties or the realized value of goodwill<sup>95</sup>).

Note that such a framework allows us to analyze a complete range of entitlement protections that a court might utilize, including (as luck would have it) the two undivided property rule options analyzed in the previous section. Indeed,  $D = 0$  corresponds to a legal rule that awards the employee an unfettered right to appropriate the customer—that is, a property entitlement for the employee to compete freely. Conversely,  $D = \infty$  corresponds to a legal rule that imposes heavily punitive damages on the employee, effectively deterring her from ever appropriating the customer. Finally,  $D \in (0, \infty)$  represents a continuum of pro-employer entitlements protected by a liability rule with damages  $D$ .<sup>96</sup>

Unlike the probabilistic property rules addressed above, liability rules endow each of  $A$  and  $B$  with a different form of fractional entitlement: long and short positions (respectively) in a “call option,” where the underlying asset is the right to compete with the firm for its customer base, and where the strike price is equal to  $D$ . Thus, the respective structural payoffs of the parties here become slightly more involved than before, and we take each of them up in turn.

Consider first the employee's decision. Once the value of  $v$  is realized, she must choose whether to stay at the firm or to leave and compete with  $A$ . She will leave if and only if expected rents available ( $\sigma\kappa v$ ) are sufficiently high to justify paying damages ( $D$ ).<sup>97</sup> Viewed at the point of realization of  $v$ , then,  $B$ 's expected payoff (ignoring any sunk costs) is given by:

$$w + \max \{ \sigma\kappa v - D, 0 \} \tag{4}$$

As viewed from the time of investment, then,  $A$ 's expected payoff consists of the expectation of this revenue stream less his private costs of effort. Accordingly, the employee's ex ante expected payoff  $\pi_A(a, b)$  is given by:

$$\pi_A(a, b) = w + (\sigma\kappa) \cdot e^{-\rho(a,b)} \cdot (\theta a + (1 - \theta)b) - \frac{a^2}{2}, \tag{5}$$

<sup>95</sup>A later section (not yet written) will consider what is possible when  $v$  is verifiable.

<sup>96</sup>Note that our analysis allows as well for  $D = w$ , so that the agent may appropriate the customer, but only if she is willing to forego receiving any wages from the firm.

<sup>97</sup>Note from this condition that we implicitly assume that the agent pays  $D$  as soon as she chooses to go into competition with the employer, regardless of who actually prevails in such a competition. Our results change little if one assumes that damages are paid only in the event of a successful challenge.

where  $\rho(a, b) = \frac{D \cdot (\sigma\kappa)^{-1}}{(\theta a + (1-\theta)b)}$ .

Now consider the employer's problem. From the employee's payoff in (5), it is relatively straightforward to derive  $B$ 's expected payoff,  $\pi_B(a, b)$ . Indeed,  $B$  can be thought of as having an entitlement to  $v$ , but less (i) the wage obligation to  $A$ ; (ii) the call option (described above) held by  $A$ ; and (iii) the employer's cost of effort. Consequently, the employer's payoff is given by:

$$\pi_B(a, b) = \left[ 1 - (1 - \kappa + \sigma\kappa) \cdot e^{-\rho(a, b)} \right] (\theta a + (1 - \theta)b) - w - \frac{b^2}{2} \quad (6)$$

Using these payoffs, it is possible to gain purchase on what is implied by incentive compatibility. The lemma below (whose proof appears in the appendix) characterizes the equilibrium choices of the players given  $D$ .

**Lemma B:** *Investment choices of effort  $a^*$  and  $b^*$  are incentive compatible under a given liability rule  $D \in [0, \infty)$  if and only if the following conditions are satisfied:*

$$a^* = \theta \cdot (\sigma\kappa) \cdot (1 + \rho(a^*, b^*)) \cdot e^{-\rho(a^*, b^*)} \quad (IC_A)$$

$$b^* = (1 - \theta) \cdot \left[ 1 - (1 - \kappa + \sigma\kappa) \cdot e^{-\rho(a^*, b^*)} \cdot (1 + \rho(a^*, b^*)) \right]. \quad (IC_B)$$

The interpretation of  $(IC_A)$  and  $(IC_B)$  is conventional and intuitive. They both state that the marginal costs of investments in goodwill ( $a^*$  and  $b^*$ , respectively) must each be equal to the respective marginal expected benefits, represented by the right hand side of the above expressions. Incorporating Lemma B into the optimal contracting problem produces the following:

$$\begin{aligned} \underset{a, b, w, D \geq 0}{Max} \quad & \pi_A(a, b) + \pi_B(a, b), \quad \text{subject to :} \\ & \text{(i) } a \text{ satisfies } (IC_A) \\ & \text{(ii) } b \text{ satisfies } (IC_B) \\ & \text{(iii) } \pi_A(a, b) \geq \bar{w} \\ & \text{(iv) } \pi_B(a, b) \geq F \\ & \text{(v) } w \geq -Y \end{aligned}$$

Analysis of this problem leads to Proposition 4 (whose proof appears in the appendix):

**Proposition 4:** *Consider the choice among liability rule entitlements  $D \in [0, \infty)$ , and the associated equilibrium investment strategies  $a^*$  and  $b^*$  defined by  $(IC_A)$  and  $(IC_B)$  in Lemma B. The optimal level of damages,  $D^*$ , is characterized by:*

$$D^* = \begin{cases} \infty & \text{if } \frac{\theta}{1-\theta} < N_0 \\ 0 & \text{if } \frac{\theta}{1-\theta} > N_1 \text{ and } Y \geq Y(1) \\ D_{\kappa\sigma} & \text{if } \frac{\theta}{1-\theta} \in [N_0, N_1] \text{ and } Y \geq Y(q_D) \\ \hat{D}_{\kappa\sigma} & \text{else} \end{cases},$$

where  $q_D = e^{-\rho(a^*, b^*)} \cdot (1 + \rho(a^*, b^*))$ ;  $D_{\kappa\sigma}$  is the unique the interior solution to  $q_D = q_{\kappa\sigma}$ ;  $\widehat{D}_{\kappa\sigma}$  is the unique interior solution to  $Y = Y(q_D)$ ; and  $N_0, N_1, q_{\kappa\sigma}, Y(q)$  are as stated in Proposition 3.

Upon inspection, it should be clear Proposition 4 bears a striking resemblance to Proposition 3. Indeed, it turns out that within our framework, solving for the optimal damages  $D^*$  is a “mathematical dual” to the problem of solving for the optimal fractional entitlement  $q^*$ .<sup>98</sup> Thus, if an optimal fractional entitlement would give each party a partial entitlement to the asset (i.e.,  $q^* \in (0, 1)$ ), the optimal liability rule would similarly prescribe a moderate quantum of damages, designed specifically to deter some—but not all—appropriations. Because of this duality, all of the findings from Proposition 3 carry over (subject to a simple transformation) to a world of liability rules.<sup>99</sup>

Table 2 describes the qualitative relationship between the optimal damages and other deep parameters of the model. As with fractional entitlements and undivided property rules, it is clear once again that the optimal liability rule continues to turn on a comparison of the parties’ relative marginal abilities to enhance consumer goodwill. When the comparative advantage sits one-sidedly with the employer (Region 1), the optimal rule tends toward a pro-employer property rule, and vice versa when the employee has the one-sided advantage (Region 3). However, when the parties’ relative skills are commensurate with one another (Region 2), the optimal liability rule imposes interior damages, and thus would envision at least some appropriations for sufficiently large realizations of  $v$ . Note also from the table that in a world of liability rules, the employee’s wealth constraint does not militate in favor of pro-employer property entitlements.<sup>100</sup> At best, a binding wealth constraint simply implies that the level of damages be increased (perhaps from zero) to the point where the wealth constraint no longer is binding.

	Region 1 $\frac{\theta}{1-\theta} < N_0$	Region 2 $N_0 \leq \frac{\theta}{1-\theta} \leq N_1$	Region 3 $\frac{\theta}{1-\theta} > N_1$
$Y(q_D)$ not binding	<i>Prop. Rule: B</i>	<i>Liab. Rule</i>	<i>Prop. Rule: A</i>
$Y(q_D)$ binding	$n/a$ <sup>101</sup>	<i>Liab. Rule</i>	<i>Liab. Rule</i>

Table 2

<sup>98</sup>This result is proven in Lemma C, which can be found in the appendix.

<sup>99</sup>We conjecture that this duality result carries over to other continuous distributional assumptions on  $v$  (beyond exponential) that exhibit monotone hazard rates in the parties’ joint effort. As of now, however, this assertion remains a conjecture.

Moreover, it should be noted that this duality need not exist in all contexts. Ayres and Talley (1995), for example, compare fractional entitlements and liability rules within a Coasean environment with two-sided incomplete information and no investment. In such a setting, this duality result no longer holds.

<sup>100</sup>The same caveat applies here as in note —, supra.

<sup>101</sup>So long as Assumption 1 holds, the agent’s wealth constraint will never bind with a pro-principal property rule.

Hence, once again there is no a priori reason to think that “most” employment arrangements will fall in the Northwest cell of the above table. Indeed, just as in the previous subsection, contractual environments that are likely to fall outside Region 1 include those in which:

- The employee possesses even moderate skills at building up goodwill (i.e.,  $\frac{\theta}{1-\theta}$  is not too small);
- Post-termination competition between employer and employee is not too destructive and/or inter se transaction costs are small (i.e.,  $\kappa$  is large); and
- The employer either is partially effective at retaining existing customers in the face of competition with the employee and/or she has a large amount of ex post bargaining power (i.e.,  $\sigma$  is relatively small).

Because choosing among damages rules is a mathematical dual to choosing among fractional property rights, entitlements protected by a liability rule represent a viable and legitimate policy option when fractional entitlement schemes are unavailable. Indeed, liability regimes do not require the court to ‘divide the baby’ explicitly. They do they require the creation and maintenance of an uncertain, probabilistic doctrine. They do not even require that the court take into account any information beyond that needed to assign an undivided property right optimally.<sup>102</sup> Rather, all a liability rule requires is that the court be able to identify when an employee is utilizing trade secrets to compete with the former employer.

## 4 Caveats and Extensions

While the previous section has made a number of interesting and pertinent observations, for the sake of presentation we have not tarried long in addressing various caveats to both our theoretical analysis and the doctrinal applications thereof. This section explores four such caveats. First, we note that the duality between fractional entitlements and liability rules demonstrated above can also be extended to mixed regimes, involving compound compositions of entitlement regimes. Second, we discuss one of the principal doctrinal implications of this duality result: the under-determinacy of an ‘optimal’ doctrine. Third, we address whether (and to what extent) ordinary courts could be expected, given well-recognized administrative constraints, to be able to implement the various divided entitlement regimes noted above. And finally, we ask how extending the model to a dynamic framework may affect our results.

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<sup>102</sup>Note, like Propositions 2 and 3, all that Proposition 4 requires is knowledge of the deep parameters  $\theta$ ,  $\kappa$ ,  $\sigma$ , and  $Y$ .

## 4.1 Mixed Regimes

One of the most interesting results from the previous section is that fractional entitlements and liability rules constitute theoretical duals from an optimal contracting standpoint. Any incentive compatible, individually rational contract that is implementable using a fractional rule  $q^*$  is also implementable using a corresponding damages rule  $D^*$ , and vice versa.

As it turns out, it is possible to generalize this statement even further to admit various mixed regimes of property and liability rules. Consider, for instance, a probabilistic legal rule that assigns ownership to the employer with probability  $(1 - q)$ , and gives the employee an entitlement to compete freely with probability  $q$ . Moreover, suppose that when the entitlement is assigned to the employer, it is protected — not by the spectre of an injunction — but rather by a strict liability rule with damages  $D$ . From the previous section, we know that it is possible to represent the liability rule by its dual: a fractional assignment of shares  $q_D$  and  $(1 - q_D)$ , respectively, to the employee and employer. And thus, the mixed regime hypothesized above is equivalent (from an efficiency perspective) to a simple probabilistic assignment in which the employer receives an undivided property right with probability  $(1 - q_D) \cdot (1 - q)$ , and otherwise the employee receives an entitlement to compete freely. This reasoning (in a more general form) is reflected in the following corollary:

**Corollary 1:** *Any probabilistic mixture of  $N$  distinct liability rules  $\{D_1, D_2, \dots, D_N\} \in \mathfrak{R}_+^N$  and  $M$  distinct fractional assignments  $\{q_1, q_2, \dots, q_M\} \in [0, 1]^M$  can be represented by a single fractional entitlement assignment  $q_{MN} \in [0, 1]$ .*

As Corollary 1 states, the duality result from the previous section is rather generalizable and powerful. This observation is important for both analytical and practical reasons. From an analytical perspective, it suggests that modeling the optimal legal rule as a choice among fractional entitlements does not ‘miss’ important considerations implicit within a more complex universe of rules. But moreover, from a practical perspective, it suggests that uncertainty about damages under a liability rule may play a similar role as that played by the uncertainty about the identity of the entitlement holder analyzed above. Thus, when a probabilistic property right would be optimal but difficult to maintain, there may be other dimensions (e.g., damages) where systematic uncertainty is significantly more durable and does an equally good job.

In theory, it would be possible to generalize Corollary 1 even further to include other forms of entitlement not considered here. So long as the employee’s wealth constraint does not bind, Corollary 1 carries over to a vast array of even more ‘exotic’ option-like entitlements, such as giving  $A$  a ‘put’ (rather than a call) option on the trade secret, allowing him to force payment from  $B$  in the event that  $A$  abstains from appropriating the asset.<sup>103</sup> We do not address such entitlement forms here, however, for two reasons. First, such schemes are so far

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<sup>103</sup>Indeed, a number of other exotic-sounding entitlement forms are possible. See Ayres & Goldbart (2000) for a synopsis.

from what one observes in practice that their implementation would require a significant overhaul of existing doctrine. And second, while they are equivalent on incentive grounds, put rules such as this are distributionally non-neutral, and many of them would require that the employee post a significantly larger bond *ex ante* in exchange for his entitlement to a larger downstream portion of rents — a bond that would frequently violate his wealth constraint.

## 4.2 The Duality Dilemma

A second caveat worth mentioning explicitly deals with the darker flip-side of duality. Indeed, as Corollary 1 states, there is an infinite continuum of hybrid fractional and liability-rule entitlements that are outcome equivalent. While such added degrees of freedom are emancipating for theoreticians, they pose some particularly stark difficulties for legal doctrine. Explicitly, the duality of fractional entitlements and liability rules implies the absence of a unique ‘model code’ approach to an optimal doctrine. Consider, for example, the framework from the previous section, in which we arbitrarily set  $\sigma = \kappa = 1$ ,  $\theta = 1/2$ , and  $Y > Y(1)$ . It is easily verified that the optimal liability rule in this case is given by  $D^* = 0.42$ , and that the optimal fractional assignment is given by  $q^* = 0.5$ . Both of these entitlement schemes achieve equivalent levels of social welfare ( $ESW = 3/16$ ), which — as it turns out — is the best one can accomplish when  $a$  and  $b$  are not verifiable. As such, it is conceivable that two jurisdictions could adopt entirely different legal regimes — one imposing a fractional (e.g., probabilistic) set of property rules, the other imposing a moderate yet certain liability rule — yet both jurisdictions would have adopted an ‘optimal’ doctrine. Because of this indeterminacy, it is more difficult (and perhaps impossible) for us to conjure up single, doctrinal soundbite for judges or legislators to follow while searching for “the” optimal doctrine.

Nevertheless, doctrinal duality does not prevent us from saying anything at all about the question. Indeed, no matter how a court decides to protect trade secrets, our analysis suggests that its decision about the strength of such protection will ultimately hinge on a number of common considerations, including (1) the marginal abilities of the employee relative to the employer at enhancing goodwill; (2) the extent to which, if protection to the employer is denied, ensuing competition is likely to dissipate rents; (3) the likely market shares of the litigants in such a competition; and (4) whether the employee’s wealth constraint is prohibitive. Moreover, in cases where factors (1) through (4) are relatively close calls and could thus cut either way, our analysis suggests that some form of intermediate protection is probably optimal. In such circumstances, our analysis counsels against what (we perceive to be) the predominant trend in trade secret law — that is, clear, unambiguous property rules favoring employers whenever a valuable informational asset exists.



### 4.3 Practical Administration

Although transaction cost approaches to legal doctrine can be extremely informative, they often suffer from having unrealistic expectations about what courts are able to accomplish within their administrative constraints. Indeed, as one of us has previously written,<sup>104</sup> these expectations may constitute a principal weakness of the transaction cost approach.

It should not be surprising, then, that similar administrative concerns implicate our analysis. For even if one assumes the importance of the analytical points elucidated above, to implement them would require a court to measure a number of factors (i.e., the ‘deep’ parameters in our model) which may not be readily apparent. Such inquiries may somewhat technical and complicated, particularly in situations that are typical of trade secret cases. One might have misgivings that these evidentiary requirements would, at least in some cases, demand too much of the judicial process.

This objection is not insignificant. Indeed, the difficulty of verifying certain aspects of parties’ behavior is, in fact, a motivating premise of this paper. Such verification problems might easily plague other important factual determinations as well. At the same time, however, it is important to realize that this objection—plausible though it may be—is perhaps less problematic for our enterprise than it first appears. Indeed, recall that our model explicitly assumed that a number of relevant considerations (i.e., the values of  $a$ ,  $b$ , and  $v$ ) were simply unverifiable in court. As such, our informational assumptions about what courts can realistically accomplish already pushes in the direction of modesty.

To be sure, one might argue that courts have even more limited resources than those that we implicitly presume here. Many courts, for example, may have extreme difficulties in verifying the other deep parameters of the problem which are central to assessing factors (1) through (4) in the previous subsection.<sup>105</sup> However, whatever the plausibility of this argument, it hardly constitutes a defense of the status quo. Indeed, as demonstrated above, even an optimal *undivided* property regime hinges crucially on every single one of the above factors. Were some/all of those factors unverifiable to courts, it simply does not follow that the optimal form of protection defaults back to a pro-employer property right. Indeed, there is no *a priori* reason to believe that such a regime would dominate any other, and some reason to believe things could easily cut the other way.<sup>106</sup> Hence, the argument that courts might have a difficult time implementing our doctrinal proposals doctrine would seem to apply a fortiori to the existing legal regime. Viewed from this perspective, our approach represents an important first step (though perhaps a tentative one) in understanding how trade secret law could—and should—be more sensitive to the underlying environment.

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<sup>104</sup>See Lester (2000).

<sup>105</sup>That is,  $\theta$ ,  $\kappa$ ,  $\sigma$ ,  $\bar{w}$ , and  $F$ .

<sup>106</sup>For instance, as noted in Propositions 3 and 4, the employee’s wealth constraints to *not* generally imply the optimality of a pro-employer property rule when fractional entitlements and liability rules are available.

## 4.4 Dynamics

One potentially large limitation of the foregoing analysis is that it is static in nature. Indeed, in the model presented in Section 2, the firm lasted but for a single period. Consequently, investments made during that period were appropriable only once. What happened after the dust settled mattered little. In more realistic settings, however, a stock of goodwill is built up over time, and the parties make incremental decisions about whether to contribute to it or draw from it. One might justifiably wonder, then, how our analysis would change (if at all) in a dynamic setting.

Although we do not present a formal analysis here,<sup>107</sup> dynamic concerns can significantly affect our normative prescriptions. Nevertheless, we predict that they would do so in a relatively predictable and monotone way. In particular, we conjecture that dynamic considerations imply an optimal doctrine that *initially* grants strong (property-like) protection to employers, but progressively comes to favor the employee during the lifetime of the disputed asset. The reasons for our conjecture are as follows.

First, and most centrally, in practice the non-protection of a trade secret is frequently a type of one-way policy ratchet. If, at some period  $t$ , the prevailing legal rule permitted an employee to appropriate a trade secret for himself, it would be difficult to ‘undo’ that allocation in a subsequent period by re-entending the employer with a property right over the asset. Indeed, one of the potential reasons that competition dissipates rents in our static model is that other, third party competitors may become privy to the information and use it to enter the market. It would be difficult (if not impossible) for a court to effectively corral the use of such knowledge once it had entered the public domain. This ratcheting effect thus implies that a more cautious (i.e., pro-employer) posture is particularly desirable for newly-created informational assets.

Compounding this effect is the observation that many trade secrets have a durable character. Investments that build up a consumer goodwill today will likely enhance it tomorrow as well (subject, perhaps, to some small rate of decay). Consequently, an optimal dynamic doctrine would attempt to induce both parties to invest during the crucial early life of the asset. Given the irreversibility of non-protection, however, the only way to give both parties such incentives in a sustainable way is to divide the entitlement over time — giving a large share of the rents during early periods (through strong protection), but allowing the employee a greater share in later periods (through weakened protection).

A third factor that would lead to the dynamic doctrine we posit is the fact that the employee’s wealth constraint may well become less relevant over time. Indeed, as time passes, the employee may be able to afford contributing a small fraction of her per-period wage back to the firm — the accumulation of which can constitute a type of performance bond against subsequent appropriations. Accordingly, over time, a number of efficient (but employee-friendly) contracts that theretofore would not have been implementable because of the employee’s wealth constraint may now arrive back on the table.

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<sup>107</sup>A later version of this paper will most likely include one.

And finally, we posit that within many (if not most) contexts where customer goodwill grows over time, the employee may progressively become a more pivotal figure in the asset’s continued growth and maintenance. This is, in many ways, a simple observation about marketing. Many of the important employer-borne investments — such as advertising, market research, etc. — tend to particularly good at attracting *new* customers. However, once these customers are “in the door,” their continued loyalty increasingly turns on the perceived quality of service they are receiving — a dimension of quality that seems frequently to be the predominant province of employee-borne investments. In terms of the model from Section 2, then, this form of dynamic concern would suggest that  $\left(\frac{\theta}{1-\theta}\right)$  increases as time passes. As such, even if one dismissed all of the other dynamic issues presented above, an optimal static contract between *A* and *B* repeated over time would come incrementally to favor the employee over the employer.

Surprisingly, the sort of doctrine that these dynamic considerations suggest is, in at least some respects, even *more* inconsistent with current practice. Indeed, as we noted in the introduction, an employer’s prospects for protecting her trade secrets often grow stronger as the required “time and effort” to build up the trade secret increases.<sup>108</sup> Our arguments, in contrast, would suggest that as a “goodwill asset” ages, courts should increasingly disfavor continued protection. At the same time, however, many of the evidentiary inputs that such a dynamic doctrine would require are virtually the same as those noted in the earlier sections. Hence, while dynamic considerations would indeed change our results, they would neither render irrelevant the considerations advocated in the previous section, nor would they militate (in our minds) in favor of the status quo.

## 5 Conclusion

In this article, we have argued that existing law governing trade secrets (and related doctrines) is a poor fit in contexts where both employers and highly-skilled employees can make investments that produce informational goods (such as detailed customer lists). In particular, we have argued, the existing norm of strong property rules is poorly tailored to bring about the type of joint investment that such environments tend to invite. Consequently, efficiency-minded courts would be wise to consider broadening the scope of their inquiry beyond the binary choice between ‘full protection’ and ‘no protection,’ and should consider various partial entitlements, such as fractional assignments, liability rules, or even some combination thereof, as possible alternatives. Moreover, we have argued, an optimal doctrine in such a context would likely have a dynamic flavor that similarly diverges from current practice, granting progressively less solicitude to the claims of the employer during the lifetime of the disputed asset. While the reforms we advocate are non-trivial, we have argued that they need

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<sup>108</sup>See TAN —, supra.

not be so administratively demanding (at least relative to the status quo) to be prohibitive.

There are, of course, a number of potential extensions to our analysis that we have left unexplored (at least for now). For instance, if we are correct that current law is a poor fit in mutual-investment contexts, one would expect to observe numerous attempts by employers and employees to implement alternative allocations through contract. While casual observation suggests that this is, in fact, a relatively common practice,<sup>109</sup> a more rigorous empirical investigation would be helpful.

In addition, a subsequent analysis might explore how various non-rational heuristics and cognitive biases would affect our analysis. Though our thoughts are still nascent about such effects, we suspect that at least certain cognitive errors may actually lend support to our normative thesis. Suppose, for example, that in the framework developed in Section 2, the employee's relative skills at enhancing goodwill were 'just' insufficient (in the absence of bias) to justify abandoning a pro-employer property rule.<sup>110</sup> Suppose further, however, that the employee 'suffered' from a bias that caused him to make probabilistic assessments reflecting unjustified optimism about small probabilities of success (and, perhaps, unjustified pessimism about large probabilities of success).<sup>111</sup> Consider once again whether a pro-employer property rule would remain preferable to (say) an alternative, probabilistic entitlement, favoring the employer ninety-nine times out of a hundred, but favoring the employee the remaining one percent of the time. The alternative régime would not significantly reduce employer investments in goodwill; but the employee's overconfidence would cause her to increase her own investment *inframarginally*, as if she had a greater than one-percent chance of receiving the ultimate entitlement. In such situations, then, the threshold at which the employee's relative skills justify fractional entitlements would become discernibly more accommodating.<sup>112</sup>

Finally, we have not ventured into a general welfare analysis of various legal entitlements considered above, assuming throughout that the social objective was to maximize the expected joint payoffs to the contracting parties. A wel-

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<sup>109</sup>A number of litigated cases, for example, involve express non-compete clauses protected *not* by specific performance, but rather by moderate liquidated damages terms. See, e.g., *Jones v. Deeter* 913 P.2d 1272 (Nev. 1996) (Restrictive covenant for CEO protected by a \$50,000 liquidated damages term). *Moore v. Eggers Consulting Co., Inc.* 562 N.W.2d 534 (Neb. 1997) (\$100 liquidated damages term breach of non-compete clause); *Management Recruiters of Boulder, Inc. v. Miller*, 762 P.2d 763, (Colo.App.,1988); *Mesarvey, Russell & Co. v. Boyer* 1992 WL 185656 Ohio App. 10 Dist. (1992); *Mesarvey, Russell & Co. v. Boyer* 1992 WL 185656 (Ohio App. 10 Dist.,1992); *Bellboy Seafood Corp. v. Nathanson* 410 N.W.2d 349 Minn.App. (1987).

<sup>110</sup>E.g.,  $\frac{\theta}{1-\theta} = \hat{N} - \varepsilon$ , for some arbitrarily small  $\varepsilon$ .

<sup>111</sup>In technical terms, for some infinitesimal probability  $\varepsilon$ , the employee acted as if he utilized a probability 'weighing' function  $\pi(\varepsilon)$  such that  $\lim_{\varepsilon \rightarrow 0} \pi(\varepsilon) \gg 0$ , and  $\lim_{\varepsilon \rightarrow 1} \pi(\varepsilon) \ll 1$ . See, e.g., Thaler (1991), at 141.

<sup>112</sup>A similar analysis might also pertain to the damages manifest in liability rules. Of course, if the employer were subject to the opposite trend, the optimal judicial determination would come down to ascertaining whether the employee's unjustified optimism outweighed the employer's unjustified pessimism.

fare economics extension might prove tricky, but may lead to some interesting insights. For instance, we have assumed throughout that non-protection of an employer's trade secret will tend to dissipate the aggregate rents available to the parties once they go into competition with one another. In reality, such rents do not actually "disappear," but rather are transferred (super-additively) to other producers and to consumers. Viewed alone, such a consideration would militate in favor of even weaker trade secret protections. At the same time, however, the additional rent dissipation caused by such weaker protections would dampen both parties' ex ante incentives to invest to begin with. Complicating issues further is the fact that the 'benefit' side of this putative trade-off is at least slightly deceptive. Indeed, one would need to be sure that the phenomenon we have identified as "goodwill" is a meaningful measure of consumer welfare. To be one, it must actually proxy for some bona fide enhancement in value (because, say, of better-tailored services or more informed consumers) rather than a transitory manipulation of preferences that should receive little or no normative weight.<sup>113</sup> Such questions, while interesting, we leave for future work.

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<sup>113</sup>See Tirole (1990).

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## 7 Appendix

This appendix states and presents the proofs for various propositions that appear in the text.

**Proposition 2:** Consider the binary choice among entitlements  $q \in \{0, 1\}$ . The optimal entitlement,  $q^*$ , is given by:

$$q^* = \begin{cases} 1 & \text{if } \frac{\theta}{1-\theta} \geq \hat{N} \text{ and } Y \geq \hat{Y} \\ 0 & \text{else} \end{cases},$$

where  $\hat{N} \equiv \left(\frac{\sigma^2 + \kappa^{-2} - 1}{\sigma \cdot (2 - \sigma)}\right)^{\frac{1}{2}}$  and  $\hat{Y} \equiv F - \kappa^2 (1 - \sigma) \left(\sigma \theta^2 + \frac{(1 - \sigma)}{2} (1 - \theta)^2\right)$ .

**Proof:** Consider first a property rule favoring  $B$ . It is easily confirmed that in such a situation only the employer will invest, investing  $b^* = 1 - \theta$ . This choice will lead to an expected social welfare level of:

$$\frac{(1 - \theta)^2}{2},$$

which necessarily must weakly exceed  $(\bar{w} + F)$  for the parties' participation constraints to hold. Moreover, for each party's individual participation constraints, we must have  $w \in \left[\bar{w}, \frac{(1-\theta)^2}{2} - F\right]$ . Note that regardless of  $w$ , both parties' incentive constraints are trivially satisfied at  $\{0, b^*\}$ . Finally, since  $w \geq \bar{w} > -Y$ , the employee's wealth constraint is never binding here. Now consider the situation where the property rule favors  $A$ , and ignore  $A$ 's wealth constraint for the moment. In this case, employee will succeed in luring the customer with probability  $\sigma$ , but in the process the total available surplus for whoever wins shrinks to  $\kappa \cdot v$ . Viewed from the time of investment, then, the players' respective payoffs are given by:

$$\begin{aligned}\pi_A(a, b) &= w + \sigma \cdot \kappa \cdot (\theta a + (1 - \theta)b) - \frac{a^2}{2} \\ \pi_B(a, b) &= -w + (1 - \sigma) \cdot \kappa \cdot (\theta a + (1 - \theta)b) - \frac{b^2}{2}\end{aligned}$$

The equilibrium levels of investment are easily confirmed as  $a^* = \sigma \cdot \kappa \cdot \theta$  and  $b^* = (1 - \sigma) \cdot \kappa \cdot (1 - \theta)$ , so that the expected social welfare is equal to:

$$\begin{aligned}& \kappa \cdot (\theta \cdot a^* + (1 - \theta) \cdot b^*) - \frac{(a^*)^2}{2} - \frac{(b^*)^2}{2} \\ &= \sigma \cdot \left(\frac{2 - \sigma}{2}\right) \cdot (\kappa \cdot \theta)^2 + (1 - \sigma) \cdot \left(\frac{1 + \sigma}{2}\right) \cdot (\kappa \cdot (1 - \theta))^2\end{aligned}$$

Comparing this expression the welfare under the pro-employer rule yields the expression given in the proposition. Just as before, a necessary condition for such an entitlement to be individually rational is that the above expression must weakly exceed  $(\bar{w} + F)$ , which will always be satisfied if Assumption 1 holds. However, for the individual participation constraints to be satisfied, the wage must be such that the employer and employee each can receive at least their opportunity costs of participation. Ignoring wealth constraints, it is easily verified that the wage paid to the employee,  $w$ , must fall within the interval defined by:

$$\bar{w} - \sigma \cdot \left(\frac{2 - \sigma}{2}\right) \cdot (\kappa \cdot \theta)^2 \leq w \leq (1 - \sigma) \cdot \left(\frac{1 + \sigma}{2}\right) \cdot (\kappa \cdot (1 - \theta))^2 - F$$

(This is a well-defined interval so long as Assumption 1 holds). Nothing presented thus far, however, prevents the upper bound this interval from taking on negative values. In such circumstances,  $A$  would have to pre-pay for the prospective chance of appropriating goodwill, yet at the same time he can afford to pay

at most  $Y$  dollars. Thus, even when optimal, the property assignment defined above is not implementable unless  $B$ 's rationality constraint can also be satisfied at the lowest possible wage of  $w = -Y$ . Equivalently, the pro-employee entitlement is implementable only if:

$$Y \geq F - (1 - \sigma) \cdot \kappa^2 \cdot \left( \sigma \cdot \theta^2 + \frac{(1 - \sigma)}{2} \cdot (1 - \theta)^2 \right) \equiv \widehat{Y},$$

which constitutes the second condition in the proposition. Note that the right hand side of this constraint is strictly decreasing in  $\kappa$ , and strictly increasing in  $F, \sigma$ , and  $\theta$ .  $\neq$

**Proposition 3:** *Consider the choice among fractional entitlements  $q \in [0, 1]$ .*

*The optimal entitlement,  $q^*$ , is given by:*

$$q^* = \begin{cases} 0 & \text{if } \frac{\theta}{1-\theta} < N_0 \\ 1 & \text{if } \frac{\theta}{1-\theta} > N_1 \text{ and } Y \geq Y(1) \\ q_{\kappa\sigma} & \text{if } \frac{\theta}{1-\theta} \in [N_0, N_1] \text{ and } Y \geq Y(q_{\kappa\sigma}) \\ \widehat{q}_{\kappa\sigma} & \text{else} \end{cases}, \text{ where}$$

$$N_0 \equiv \left( \frac{\kappa^{-1} - 1}{\sigma} \right)^{\frac{1}{2}}; \\ N_1 \equiv \begin{cases} \left( \frac{\sigma^2 + \kappa^{-1} - 1}{\sigma \cdot (2 - \sigma - \kappa^{-1})} \right)^{\frac{1}{2}} & \text{if } \kappa > \frac{1}{2 - \sigma} \\ \infty & \text{else} \end{cases}; \quad q_{\kappa\sigma} \equiv \frac{\left( \frac{1}{\sigma\kappa} \right) \cdot \left[ \left( \frac{\theta}{1-\theta} \right)^2 - N_0 \right]}{(1 - N_0^2) + \left( \frac{\theta}{1-\theta} \right)^2 (1 + 2N_0)}$$

and  $\widehat{q}_{\kappa\sigma}$  is the unique root of the equation  $Y = Y(q)$ .

**Proof:** Disregard the parties' participation constraints for now. For any  $q$ , expected social welfare is given by:

$$S(q) = (1 - q + q\kappa) \cdot (\theta a + (1 - \theta)b) - \frac{a^2}{2} - \frac{b^2}{2}$$

Because  $q$  endogenously affects  $a$  and  $b$ , one must first impose incentive compatibility on the above expression before optimizing over  $q$ . As noted in the text, the players' respective payoff functions are:

$$\pi_A(a, b) = w + (q \cdot \sigma \cdot \kappa) \cdot (\theta a + (1 - \theta)b) - \frac{a^2}{2} \\ \pi_B(a, b) = -w + ((1 - q) + q \cdot (1 - \sigma) \cdot \kappa) \cdot (\theta a + (1 - \theta)b) - \frac{b^2}{2}$$

For any  $q \in [0, 1]$ , the equilibrium investments are easily verified as  $a^* = (q \cdot \sigma \cdot \kappa) \cdot \theta$  and  $b^* = ((1 - q) + q \cdot (1 - \sigma) \cdot \kappa) \cdot (1 - \theta)$ , so that the expected social welfare is equal to:

$$\begin{aligned} S(q) &= (1 - q + q \cdot \kappa) \cdot (\theta \cdot a^* + (1 - \theta) \cdot b^*) - \frac{(a^*)^2}{2} - \frac{(b^*)^2}{2} \\ &= \theta^2 \cdot q \cdot \sigma \cdot \kappa \cdot \left( 1 - q + q \cdot \kappa - \frac{q \cdot \kappa \cdot \sigma}{2} \right) \\ &\quad + (1 - \theta)^2 \cdot ((1 - q) + q \cdot (1 - \sigma) \cdot \kappa) \times \\ &\quad \left( 1 - q + q \cdot \kappa - \frac{((1 - q) + q \cdot (1 - \sigma) \cdot \kappa)}{2} \right) \end{aligned}$$



Note that  $S(q)$  is quadratic in  $q$ , and thus it is either globally concave or convex. Consider first the case of  $q = 0$ , and ask whether it is locally optimal. Differentiating  $S(q)$  and manipulating yields the result that  $S'(0) < 0$  if and only if  $\left(\frac{\theta}{1-\theta}\right) < N_0$ , where  $N_0$  is as given in the Proposition. Thus, if this condition holds,  $q = 0$  is a *local* maximum, and, if  $S(q)$  is concave, then  $q = 0$  is a global maximum. On the other hand, if  $S(q)$  is convex, then  $q = 1$  is also a local maximum and a candidate for a global maximum. However, from Proposition 2, we know that  $q = 0$  dominates  $q = 1$  on optimality grounds whenever  $\left(\frac{\theta}{1-\theta}\right) < \hat{N}$ . And, since  $N_0 < \hat{N}$ ,  $q = 0$  must constitute a global maximum when  $\left(\frac{\theta}{1-\theta}\right) < N_0$ .

Now consider first the case of  $q = 1$ , and ask under what conditions it is locally optimal. Differentiating  $S(q)$  and manipulating yields the result that  $S'(1) < 0$  if and only if  $\left(\frac{1-\theta}{\theta}\right)^2 > \frac{\sigma(2\kappa-1-\sigma\kappa)}{(1-\kappa+\kappa\sigma^2)} \equiv (N_1)^{-2}$ . When the numerator of the right hand side fraction in the inequality is strictly positive, simply take square roots of both sides and invert to yield the condition  $\left(\frac{\theta}{1-\theta}\right) > N_1$  as given in the theorem. When the numerator is negative, however, the  $N_1$  is not defined. It is easily confirmed that  $S(q)$  is concave in this region, and thus local optimality suffices for global optimality.

Finally, consider situations where  $\left(\frac{\theta}{1-\theta}\right) \in [N_0, N_1]$ . Differentiating  $S(q)$  produces first order conditions from which the expression for  $q(\sigma, \kappa)$  emerges. The first order conditions are sufficient because  $S(q)$  is strictly concave  $\forall \left(\frac{\theta}{1-\theta}\right) > N_0$ , a condition that holds in this region by hypothesis.

In all of the above derivations, we have assumed that the parties' participation constraints were not binding. However, the condition for individual rationality when  $q = 1$  is simple:  $\frac{(1-\theta)^2}{2} > \bar{w} + F$ , which is implied by Assumption 1. Moreover, because this inequality always holds at  $q = 1$ , then it will also hold for the optimal  $q$ , even if it differs from 1. However, for lower values of  $q$ , the employee's wealth constraint may be binding; if it is, there is a maximal  $q$  satisfying the employer's individual rationality constraint at  $w = Y$ , such that  $\pi_B(a^*, b^*) = 0$ . It is easily confirmed that this value for  $q$  is given by the root of  $Y = Y(q)$ , which has only one positive root in  $[0, 1]$ , thus yielding the expression for  $\hat{q}_{\kappa\sigma}$  given in the text.  $\forall$

**Lemma B:** *Investment choices of effort  $a^*$  and  $b^*$  are incentive compatible under a given liability rule  $D \in [0, \infty)$  if and only if the following conditions are satisfied:*

$$a = \theta \cdot (\sigma\kappa) \cdot (1 + \rho(a, b)) \cdot e^{-\rho(a, b)} \quad (IC_A)$$

$$b = (1 - \theta) \cdot \left[ 1 - (1 - \kappa + \sigma\kappa) \cdot e^{-\rho(a, b)} \cdot (1 + \rho(a, b)) \right]. \quad (IC_B)$$

**Proof:** Begin with  $A$ , and recall that his ex ante expected payoff is given by:

$$\pi_A(a, b) = w + (\sigma\kappa) \cdot (\theta a + (1 - \theta)b) \cdot e^{-\rho(a, b)} - \frac{a^2}{2},$$

where  $\rho(a, b) = \frac{D \cdot (\sigma\kappa)^{-1}}{(\theta a + (1 - \theta)b)}$ . Note at this point that  $\frac{d}{da} e^{-\rho(a, b)} = \left[ e^{-\rho(a, b)} \cdot \rho(a, b) \frac{\theta}{(\theta a + (1 - \theta)b)} \right]$ , and that  $\frac{d}{db} e^{-\rho(a, b)} = - \left[ e^{-\rho(a, b)} \cdot \rho(a, b) \frac{(1 - \theta)}{(\theta a + (1 - \theta)b)} \right]$ . The employee will therefore choose  $a \geq 0$  to maximize  $\pi_A(a, b)$ , which — for an interior choice of  $a$  — implies the following first order condition:

$$a = \theta \cdot (\sigma\kappa) \cdot (1 + \rho(a, b)) \cdot e^{-\rho(a, b)} \quad (8)$$

Similarly,  $B$ 's expected payoff,  $\pi_B(a, b)$ , is given by:

$$\pi_B(a, b) = \left[ 1 - (1 - \kappa + \sigma\kappa) \cdot e^{-\rho(a, b)} \right] (\theta a + (1 - \theta)b) - w - \frac{b^2}{2}$$

And thus, the employer will choose  $b \geq 0$  to maximize  $\pi_B(a, b)$ , and accordingly, his optimal choice — if interior — must satisfy the following first-order condition:

$$b = (1 - \theta) \cdot \left[ 1 - (1 - \kappa + \sigma\kappa) \cdot e^{-\rho(a, b)} \cdot (1 + \rho(a, b)) \right]. \quad (9)$$

The above first order conditions will characterize the equilibrium only if they adequately describe the players' strategies in all possible environments. In other words, we need to be sure that neither player is at a corner solution in her investment choice. Thus, let us begin with  $A$ 's choice. Fix any  $b = \bar{b} \geq 0$ . The first order condition in (8) becomes:

$$a = \theta \cdot (\sigma\kappa) \cdot (1 + \rho(a, \bar{b})) \cdot e^{-\rho(a, \bar{b})} \quad (10)$$

Because  $A$ 's expected payoff is concave, this also a sufficient condition for any interior maximum. Noting that  $\rho(a, \bar{b}) \in [0, \infty)$ , it is easily confirmed that the right hand side of the above expression is always non-negative, and thus the marginal expected benefit to the employee of investment is always nonnegative. Moreover, because the marginal cost of investment at  $a = 0$  is also zero, the solution  $a^*$  of (8) is always nonnegative, even when not constrained to be so. Therefore, if the employee is ever at a corner solution of  $a^* = 0$ , it will be one that is 'just' binding rather than strictly binding, and hence (8) fully characterizes her strategy.

Now consider  $B$ 's choice. Fix some  $a = \bar{a} \geq 0$ . Now, the FOC in (9) becomes:

$$b = (1 - \theta) \cdot [1 - (1 - \kappa + \sigma\kappa) \exp \{-\rho(\bar{a}, b)\} \cdot (1 + \rho(\bar{a}, b))].$$

Now, similar the earlier case, to show that the optimal choice of  $b$  is always non-negative, we must demonstrate that the right hand side of the above expression is always nonnegative. Equivalently, we must show:

$$1 \geq (1 - \kappa + \sigma\kappa) \exp \{-\rho(\bar{a}, 0)\} \cdot (1 + \rho(\bar{a}, 0)) \quad (11)$$

To do so, we presume first that  $B$  is at an interior solution.<sup>114</sup> We then characterize it; and show that above condition can only be satisfied by some  $b^* \geq 0$ , thereby validating our presumption. Hence, if both parties are at interior solutions, we know from (8) and (9) that the following relationship exists between the parties optimal choices:

$$\frac{a/\theta}{\sigma\kappa} = e^{-\rho(a,b)} \cdot (1 + \rho(a,b)) = \frac{1 - b/(1 - \theta)}{(1 - \kappa + \sigma\kappa)}$$

Solving for  $a$  yields:

$$a(b) = \frac{\sigma\kappa}{(1 - \kappa + \sigma\kappa)} \left( \theta - \frac{\theta}{(1 - \theta)} b \right)$$

Substituting this into the definition of  $\rho(a, b)$  gives:

$$\rho(a(b), b) = \frac{D \cdot (\sigma\kappa)^{-1}}{\left( \theta^2 \frac{\sigma\kappa}{(1 - \kappa + \sigma\kappa)} - \frac{\theta^2}{(1 - \theta)} b \frac{\sigma\kappa}{(1 - \kappa + \sigma\kappa)} + (1 - \theta)b \right)}.$$

Now,  $B$ 's solution will be interior if (11) is satisfied at  $b = 0$ . Evaluating  $\rho(\cdot)$  at this point yields:

$$\rho(a(0), 0) = \frac{D}{\theta^2} \frac{(1 - \kappa + \sigma\kappa)}{(\sigma\kappa)^2};$$

Substituting this expression into (11), we wish to demonstrate that:

$$1 \geq (1 - \kappa + \sigma\kappa) \exp \left\{ -\frac{D}{\theta^2} \frac{(1 - \kappa + \sigma\kappa)}{(\sigma\kappa)^2} \right\} \cdot \left( 1 + \frac{D}{\theta^2} \frac{(1 - \kappa + \sigma\kappa)}{(\sigma\kappa)^2} \right)$$

which is equivalent to

$$\frac{1}{(1 - \kappa + \sigma\kappa)} \geq e^{-D\xi} (1 + D\xi)$$

where  $\xi = \frac{(1 - \kappa + \sigma\kappa)}{\theta^2 (\sigma\kappa)^2} > 0$ . While this expression clearly holds for some values of  $D$ , to determine whether it holds globally we must find the sharpest bound of the right-hand side of the above expression. To this end, note that  $\frac{d}{dD} (e^{-D\xi} (1 + D\xi)) = -\xi^2 e^{-D\xi} D < 0$ , and thus the sharpest bound is at  $D = 0$ . Evaluating (11) at this point yields:

$$\frac{1}{(1 - \kappa + \sigma\kappa)} \geq 1$$

which is clearly satisfied  $\forall (\sigma, \kappa) \in [0, 1]^2$ . Thus, the right hand side of (9) is non-negative, and  $B$  is always at either an interior solution or a corner solution that is 'just' binding.  $\pounds$

Using Lemma B, we now state and prove a related lemma that is we use to prove Proposition 4:

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<sup>114</sup>Actually, we assume an interior solution for both parties. But from the above analysis, we know this is always true for  $A$ .

**Lemma C:** *For any liability rule  $D$  and equilibrium investments  $a^*(D)$  and  $b^*(D)$ , there exists a unique fractional entitlement  $q_D$  with associated equilibrium investments  $\widehat{a}(q_D)$  and  $\widehat{b}(q_D)$  such that  $a^*(D) = \widehat{a}(q_D)$  and  $b^*(D) = \widehat{b}(q_D)$ .*

**Proof:** From the analysis of fractional entitlements in Subsection 3., we know that  $\widehat{a}(q_D)$  is continuous and strictly increasing from  $\widehat{a}(0) = 0$  to  $\widehat{a}(1) = \sigma\kappa\theta$ . Likewise, we know that  $\widehat{b}(q_D)$  is continuous and strictly decreasing from  $\widehat{b}(0) = (1 - \theta)$  to  $\widehat{b}(1) = \kappa(1 - \sigma)(1 - \theta)$ . As such, we can define their inverse functions  $\widehat{a}^{-1}(\cdot)$  and  $\widehat{b}^{-1}(\cdot)$  as follows:

$$\begin{aligned}\widehat{a}^{-1}(a) &= q_a = \frac{a}{\sigma \cdot \kappa \cdot \theta} \\ \widehat{b}^{-1}(b) &= q_b = \frac{1 - b / (1 - \theta)}{(1 - (1 - \sigma) \cdot \kappa)}\end{aligned}$$

Equilibrium of this game also means equilibrium of these inverse functions, and thus  $\widehat{a}^{-1}(a) = q_a = q_b = \widehat{b}^{-1}(b)$ . In turn, this observation implies that for every value of  $q_D$ :

$$\frac{a(q_D) / \theta}{(\sigma\kappa)} = \frac{1 - b(q_D) / (1 - \theta)}{(1 - \kappa + \sigma\kappa)} \quad (12)$$

Now consider a liability rule  $D$ . From Lemma 4, we know that the players' first order conditions fully characterize the equilibrium. Combining these first order conditions yields the following condition, which must always be satisfied at equilibrium  $\{a^*(D), b^*(D)\}$  for every value of  $D$ :

$$\frac{a^*(D) / \theta}{(\sigma\kappa)} = \frac{1 - b^*(D) / (1 - \theta)}{(1 - \kappa + \sigma\kappa)} \quad (13)$$

Note that (12) and (13) are identical. Clearly, then, the relationship between  $a^*$  and  $b^*$  is identical to the relationship between  $\widehat{a}(q_D)$  and  $\widehat{b}(q_D)$ . Similarly, we know that under a liability rule  $D$ ,  $\lim_{D \rightarrow 0} a^*(D) = \sigma\kappa\theta$ ,  $\lim_{D \rightarrow \infty} a^*(D) = 0$ ,  $\lim_{D \rightarrow 0} b^*(D) = \kappa(1 - \sigma)(1 - \theta)$ , and  $\lim_{D \rightarrow \infty} b^*(D) = (1 - \theta)$ , and that the first order conditions defined by (8) and (9) are everywhere continuous and finite for all  $D$ . Jointly, these observations imply a pair of continuous equilibrium strategies  $a^*(D)$  and  $b^*(D)$  over the same range as  $\widehat{a}(q_D)$  and  $\widehat{b}(q_D)$ . Therefore, we know that there must exist at least one value of  $q_D$  that implements the same investment levels as  $D$ . To show that  $q_D$  is unique, one may simply invoke the implicit function theorem on (8) and (9) to show that  $a^*(D)$  and  $b^*(D)$  are strictly decreasing and increasing, respectively, in  $D$ .  $\yen$

**Proposition 4:** *Consider the choice among liability rule entitlements  $D \in [0, \infty)$ , and the associated equilibrium investment strategies  $a^*$  and  $b^*$  defined by  $(IC_A)$  and  $(IC_B)$  in Lemma B. The optimal level of damages,*

$D^*$ , is characterized by:

$$D^* = \begin{cases} \infty & \text{if } \frac{\theta}{1-\theta} < N_0 \\ 0 & \text{if } \frac{\theta}{1-\theta} > N_1 \text{ and } Y \geq Y(1) \\ D_{\kappa\sigma} & \text{if } \frac{\theta}{1-\theta} \in [N_0, N_1] \text{ and } Y \geq Y(q_D) \\ \widehat{D}_{\kappa\sigma} & \text{else} \end{cases},$$

where  $q_D = e^{-\rho(a^*, b^*)} \cdot (1 + \rho(a^*, b^*))$ ;  $D_{\kappa\sigma}$  is the unique the interior solution to  $q_D = q_{\kappa\sigma}$ ;  $\widehat{D}_{\kappa\sigma}$  is the unique interior solution to  $Y = Y(q_D)$ ; and  $N_0, N_1, q_{\kappa\sigma}, Y(q)$  are as stated in Proposition 3.

**Proof:** The proof follows directly from Proposition 3. Because of Lemma C, we know that for every value of  $D$ , there is a dual problem using a unique probabilistic entitlement  $q_D$ . Hence, all that is necessary is to specify the appropriate transformations between  $D$  and  $q_D$ . Clearly, when  $\frac{\theta}{1-\theta} < N_0$ , the optimal value of  $q_D = 0$ , giving the employer the undivided property right, which is consistent with a value of  $D^* = \infty$ , which has the same effect. Conversely, when  $\frac{\theta}{1-\theta} > N_1$ , the optimal value of  $q_D = 1$ , giving the employee an unencumbered entitlement to use the trade secret., which is equivalent to  $D^* = 0$ . Recall from the first order conditions under a liability rule  $D$ , that:

$$\frac{a/\theta}{\sigma\kappa} = e^{-\rho(a^*, b^*)} \cdot (1 + \rho(a^*, b^*)) = \frac{1 - b/(1 - \theta)}{(1 - \kappa + \sigma\kappa)}. \quad (14)$$

However, we also know that under a fractional entitlement  $q$ ,

$$\frac{a/\theta}{\sigma\kappa} = q = \frac{1 - b/(1 - \theta)}{(1 - \kappa + \sigma\kappa)} \quad (15)$$

Clearly then, the fractional value that constitutes the dual to damages  $D$  is given by  $q = q_D = e^{-\rho(a^*, b^*)} \cdot (1 + \rho(a^*, b^*))$ . Applying this transformation to the expressions for  $q_{\kappa\sigma}$  and  $\widehat{q}_{\kappa\sigma}$  yields the remaining expressions in the proposition.  $\pounds$

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