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Duality in Contract and Tort

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Abstract

We study situations in which a single investment serves the dual role of increasing the expected value of a contract (a reliance investment) and reducing the expected harm of a post-performance accident (a care investment). We show that failing to account for the duality of the investment leads to inefficient damages for breach of contract and inefficient standards for due care in tort. Conversely, we show that accounting for the duality yields contract damage measures and tort liability rules that provide correct incentives for efficient breach and reliance in contract and for efficient care in tort.

Keywords: contract, duality, efficiency, externalities, tort.
JEL classifications: K12, K13.

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1 Introduction

Both the common law and civil law treat contract and tort as distinct areas of private law. Law schools teach these subjects as separate courses. Legal treatises preserve their doctrinal segregation. Perhaps most importantly, courts substantiate the distinction between contract and tort, not only through their rhetoric,[1] but also by attaching legal consequences to the question of whether an action is properly viewed as a contract or tort case.[2]

Real legal problems, however, sometimes cross the doctrinal boundary between contract and tort. In this paper we study one such problem—which we call a *dual investment* problem. A dual investment problem is a situation in which a single investment both increases the expected value of a contract and reduces the expected harm of a post-performance accident. Dual investment situations span the jurisprudential divide between contract and tort in that the investment simultaneously acts as a reliance investment, which affects the calculation of expectation damages in the event of a breach of contract, and as a care investment, which affects the determination of negligence in the event of a post-performance accident.

There are many examples of dual investment situations. For instance:

- **Tank car shell** (cf. *Globe Refining Co. v. Landa Cotton Oil Co.*, 190 U.S. 540 [1903]). A refinery contracts with an oil producer for the supply of crude oil. The refinery sends a tank car to the producer's mill to collect the oil. The refinery must invest in the shell thickness of the tank car. A thicker shell reduces the risk of a leak, which both increases the expected value of the oil contract and reduces the risk of environmental harm.

- **Zoo animal enclosure** (cf. *McKinney v. San Francisco*, 109 Cal. App. 2d 844 [1952]). A city zoo contracts with China for the loan of a giant panda. The zoo must invest in a panda habitat with glass walls. Higher walls reduce the risk of escape, which both increases the expected value of the panda loan and reduces the risk of human attack.[3]

- **Drone operator training** (cf. *Nourmand v. Great Lakes Drone Co.*, A-18-777634-C [Nev. Dist. Ct. 2019]). A hotel leases several drones from a drone company. The hotel plans to stage a drone light show to enhance its Independence Day fireworks display. The hotel must invest in training for its employees who will operate the drones. Greater

[1] See, e.g., Sommer v. Federal Signal Corp., 79 N.Y.2d 530 (1992) (stating that some claims sound in contract while others sound in tort).

[2] See, e.g., Busch v. Interborough Rapid Transit Co., 187 N.Y. 88 (1907) (holding that whether the Municipal Court has jurisdiction turns on the question of whether the action is one of contract or of tort); Loehr v. East Side Omnibus Corp., 18 N.Y.S.2d 629 (App. Div. 1940), aff'd, 287 N.Y. 670 (1941) (holding that the plaintiff's action, though pleaded in contract, is a tort action and therefore barred by the shorter statute of limitations applicable to tort cases).

[3] Though rare, there are cases of giant pandas attacks on humans including at zoos (Zhang et al. 2014).

training increases the quality of the show and reduces the risk of a crash, which both increases the expected value of the drone lease and reduces the risk of spectator injury.

- **Electric power distribution** (cf. *Conderman v. Rochester Gas & Electric Corp.*, 687 N.Y.S.2d 213 [Sup. Ct. 1998], aff'd as modified, 693 N.Y.S.2d 787 [App. Div. 1999]). An electric utility contracts with an electricity supplier for the supply of electricity to its distribution system. The utility must invest in the class of its utility poles. A superior class reduces the risk that the pole will break and fall, which both increases the expected value of the supply contract and reduces the risk of bystander injury.

In section 2 we provide a detailed analysis of the "tank car shell" example listed above as a way to illustrate the main ideas of the paper.

We present a general analysis of the dual investment problem in section 3. We consider a stylized dual investment situation in which a buyer and a seller enter into a contract for the production and sale of a good at a fixed price. Upon delivery the buyer will use the good in a risky activity that has the potential to benefit the buyer but also has the potential to harm a third party. However, the seller's cost of production is uncertain at the time the contract is made, making the seller's performance of the contract uncertain as well. Before the seller realizes her production cost and decides whether to perform or breach the contract, the buyer has the opportunity to make a single investment, which is non-salvageable and has non-decreasing marginal cost, that serves the dual purpose of increasing the expected value of the contract to the buyer (a reliance investment) and reducing the expected harm to the third party (a care investment). If the contract is performed and the third party is subsequently harmed, the buyer will be liable for negligence if his investment is less than the legal standard of due care set by the court.

We show that if courts fail to account for the dual nature of the buyer's investment, this leads to inefficient damages for breach of contract and inefficient standards for due care in tort. More specifically, courts will set expectation damages that induce the seller to breach too frequently (i.e., breach when it would be efficient to perform) or too infrequently (i.e., perform when it would be efficient to breach), and set excessive due care standards which, depending on the distortion in the seller's breach probability, induce the buyer to overinvest or underinvest relative to the efficient level. Conversely, we show that accounting for the duality yields contract damage measures and negligence due care standards that provide correct incentives for efficient breach by the seller and for efficient investment by the buyer.[4]

In section 4 we consider three extensions of our baseline model and analysis: (i) the buyer will be held strictly liable for all third-party harm; (ii) the third party can also take care

[4] As we emphasize in our concluding discussion in section 5, we are hypothesizing that courts often may fail to account for the dual nature of the buyer's investment. We are not arguing that contract or tort law precludes courts from doing so.

against harm caused by the buyer's activity (i.e., care is bilateral); and (iii) the buyer is only liable for harm caused by his negligence (as opposed to all harm caused by his activity when he is negligent). None of these extensions changes the main message, though some actually simplify the analysis.[5] We conclude the paper in section 5 with a discussion in which we review the related academic literature and situate our contribution therewithin.

2 Illustration of the Dual Investment Problem

The following example illustrates the dual investment problem that we study in this paper. It is inspired by the case *Globe Refining Co. v. Landa Cotton Oil Co.*, 190 U.S. 540 (1903).

Globe Refining Company enters into a supply contract with Landa Oil Company pursuant to which Landa agrees to sell to Globe, and Globe agrees to buy from Landa, one tank of crude oil at the market price of \$250, "f.o.b. buyer's tank at seller's mill." One tank holds 30,000 gallons on crude oil. The abbreviation "f.o.b." stands for "freight on board." The term "f.o.b. buyer's tank at seller's mill" indicates that Globe agrees to send a tank car to Landa's oil mill and assume the cost and risk of transporting the crude oil to its oil refinery.

Globe plans to refine the crude oil into gasoline and sell the gasoline to filling stations at the wholesale price of \$0.13 per gallon, "f.o.b. buyer's tank at seller's refinery." Refining one tank of crude oil yields 15,000 gallons of gasoline at a cost of \$800. Hence the value of the crude oil to Globe is $15,000(\$0.13) - \$800 = \$1150$.

After entering into the contract, Globe rents a tank car with a shell thickness of x inches at a cost of \$1000 per inch and sends the tank car to Landa's oil mill to collect the crude oil. The minimum shell thickness is one quarter inch and the maximum is one inch.

The benefit of a thicker shell is that it reduces the risk of a leak. In particular, suppose that: (a) when transporting crude oil in a tank car there are two possible outcomes, a leak or no leak; (b) if there is a leak, then all of the crude oil will be lost and the spill will harm a third-party landowner in the amount of \$100; (c) if there is no leak, then none of the crude oil will be lost and no harm will befall the landowner; and (d) the probability of a leak while en route from Landa's oil mill to Globe's oil refinery is equal to $1 - \sqrt{x}$.

There is also a risk, however, that Landa will fail to supply the crude oil in the first place due to a cost shock. In particular, suppose that: (a) Landa's (uncertain) supply cost follows an exponential distribution with mean \$200; (b) Landa's (actual) supply cost will be realized while the (empty) tank car is en route to Landa's oil mill; (c) Landa will supply the crude oil when the tank car arrives at its oil mill if it would make a profit or if the loss it would incur is less than the damages it would pay for breach of contract; and (d) Landa will fail

[5] In an appendix we consider two additional extensions: (A) there is uncertainty about the buyer's performance of the contract and (B) the contract provides for liquidated damages.

to supply the crude oil when the tank car arrives at its oil mill if it would incur a loss that is greater than the damages it would pay for breach of contract.

Observe that the level of shell thickness x has a dual nature. From a contact perspective, x represents Globe's level of reliance on the performance of the contract. From a tort perspective, x represents Globe's level of care in preventing external harm.

2.1 The Contract Perspective

Imagine that Landa fails to supply the crude oil when the tank car arrives. Globe then sues Landa for breach of contract. Assume that the court finds in Globe's favor, rejecting Landa's defense that the cost shock excused its performance,[6] and awards expectation damages.

The efficient level of expectation damages D^* equals the expected value of the crude oil given the efficient level of shell thickness x^* minus the contract price.[7] This level of expectation damages is efficient in that it gives both Landa the correct incentives for efficient breach and Globe the correct incentives for efficient reliance.[8]

In calculating expectation damages, however, we assume that the court treats x solely as Globe's level of reliance, failing to appreciate its dual role as Globe's level of care. That is, we assume that the court accounts for the risk of Landa's (actual) non-performance, but fails to account for the risk of a (counterfactual) post-performance leak. Our presumption is that a court hearing a breach of contract case will view the case from the contract perspective and account for the (realized/salient) risk of breach, but will fail to view the case from the dual tort perspective and account for the (counterfactual/non-salient) risk of external harm.

Under the forgoing assumption, the court finds the efficient level of reliance x_r by solving the social problem from the contract perspective:

$$\max_{x\in[\frac{1}{4},1]} \$1150\sqrt{x}\left(1-\exp\left[-\frac{\$1150\sqrt{x}}{\$200}\right]\right)-\int_0^{\$1150\sqrt{x}}\frac{y}{\$200}\exp\left(-\frac{y}{\$200}\right)dy-\$1000x.$$

The first term is the expected value of the crude oil to Globe, $\$1150\sqrt{x}$, multiplied by the probability that Landa's supply cost is less than the expected value of the crude oil to Globe (i.e., the probability that performance is efficient from the contract perspective). The second term is Landa's expected supply cost conditional on performance being efficient from the contract perspective. The third term is Globe's reliance cost.

[6]See generally Restatement (Second) of Contracts ch. 11 (1981).

[7]We are assuming expectation damages as limited by the rule of Hadley v. Baxendale, 156 Eng. Rep. 145 (Ex. 1854). See, e.g., Miceli (1997, ch. 4).

[8]See infra section 2.4.

The resulting first-order condition is

$$\frac{\$575}{\sqrt{x_r}}\left(1-\exp\left[-\frac{\$1150\sqrt{x_r}}{\$200}\right]\right)-\$1000=0,$$

which implies

$$x_r = 0.30335.$$

As we will show, however, $x_r < x^*$ due to the court's failure to appreciate the dual role of x.

2.2 The Tort Perspective

Suppose now that Landa supplies the crude oil when the tank car arrives at its oil mill. Suppose further, however, that there is a leak while the tank car is en route from Landa's oil mill to Globe's oil refinery and that the spill harms a third-party landowner in the amount of \$100. The landowner then sues Globe for negligence.[9]

The efficient standard of due care equals the efficient level of shell thickness x^*. Setting the due care standard equal to x^* is efficient in that it gives Globe the correct incentives for efficient care.[10]

In calculating the due care standard, however, we assume that the court treats x solely as Globe's level of care, failing to appreciate its dual role as Globe's level of reliance. That is, we assume that the court accounts for the risk of (actual) harm to the landowner, but fails to account for the risk of (counterfactual) non-performance by Landa. Our presumption is that a court hearing a negligence case will view the case from the tort perspective and account for the (realized/salient) risk of external harm, but will fail to view the case from the dual contract perspective and account for the (counterfactual/non-salient) risk of breach.

Under the forgoing assumption, the court finds the efficient level of care x_c by solving the social problem from the tort perspective:

$$\max_{x\in[\frac{1}{4},1]} \$1150\sqrt{x}-\$100\left(1-\sqrt{x}\right)-\$1000x.$$

The first two terms, $\$1150\sqrt{x}-\$100\,(1-\sqrt{x})$, comprise the expected social value of the crude oil, including both the expected value of the crude oil to Globe and the expected harm to the landowner. The third term is Globe's care cost.

[9] Assume that Globe cannot assert the defense that the landowner was contributorily negligent. See, e.g., Kellogg v. Chicago & Northwestern Railway Co., 26 Wis. 223 (1870).

[10] See infra section 2.4.

The resulting first-order condition is

$$\frac{\$625}{\sqrt{x_c}} - \$1000 = 0,$$

which implies

$$x_c = 0.39063.$$

As we will show, however, $x_c > x^*$ due to the court's failure to take the dual perspective.

2.3 The Dual Perspective

In order to find the efficient level of shell thickness x^* we must account for the dual role of x both as Globe's level of reliance and as Globe's level of care. That is, we must account for both the risk of non-performance of the contract and the risk of a post-performance leak.

From the dual perspective the social problem is

$$\max_{x\in[\frac{1}{4},1]} \left[\$1150\sqrt{x} - \$100\left(1-\sqrt{x}\right)\right]\left(1-\exp\left[-\frac{\$1150\sqrt{x}-\$100\left(1-\sqrt{x}\right)}{\$200}\right]\right)$$
$$- \int_0^{\$1150\sqrt{x}-\$100\left(1-\sqrt{x}\right)} \frac{y}{\$200}\exp\left(-\frac{y}{\$200}\right)dy - \$1000x.$$

The first term is the expected social value of the crude oil multiplied by the probability that Landa's supply cost is less than the expected social value of the crude oil (i.e., the probability that performance is efficient from the dual perspective). The second term is Landa's expected supply cost conditional on performance being efficient from the dual perspective. The third term is Globe's dual investment cost.

This problem fully encompasses total social welfare and thus its solution is x^*. The first-order condition is

$$\frac{\$625}{\sqrt{x^*}}\left(1-\exp\left[-\frac{\$1150\sqrt{x^*}-\$100\left(1-\sqrt{x^*}\right)}{\$200}\right]\right) - \$1000 = 0,$$

which implies

$$x^* = 0.36108.$$

2.4 Implications

An immediate implication of the foregoing is $x_r < x^* < x_c$. The intuition is straightforward. From the contract perspective the risk of non-performance calls for lower levels of investment, whereas from the tort perspective the risk of external harm calls for higher levels of investment. Taking both risks into account calls for a happy (optimal) medium.

Let us highlight three additional implications.

First, the contract perspective leads the court to set expectation damages D below the efficient level. Specifically, the court sets

$$\begin{aligned} D = D_r &= \$1150\sqrt{x_r} - \$250 \\ &= \$1150\sqrt{0.30335} - \$250 = \$383.39, \end{aligned}$$

whereas the efficient level is

$$\begin{aligned} D^* &= \$1150\sqrt{x^*} - \$100\left(1 - \sqrt{x^*}\right) - \$250 \\ &= \$1150\sqrt{0.36108} - \$100\left(1 - \sqrt{0.36108}\right) - \$250 = \$401.12. \end{aligned}$$

Second, setting expectation damages below the efficient level gives Landa the wrong incentives for efficient breach. It is efficient for Landa to breach if and only if its supply cost exceeds the expected social value of the crude oil given the efficient level of shell thickness,

$$\$1150\sqrt{0.36108} - \$100\left(1 - \sqrt{0.36108}\right) = \$651.12.$$

Landa will breach the contract if its loss from performing (supply cost minus contract price) exceeds the damages for breach. Equivalently, Landa will breach if its supply cost exceeds the contract price plus expectation damages. If the court sets $D = D^* = \$401.12$, this gives Landa the correct incentives for efficient breach, because it will breach only when its supply cost exceeds $\$250 + \$401.12 = \$651.12$. If however the court sets $D = D_r = \$383.39$, then Landa will breach too frequently—whenever its supply cost exceeds $\$250 + \$383.39 = \$633.39$, and in particular when its supply cost is between \$633.39 and \$651.12.

Third, the tort perspective leads the court to set the due care standard $\overline{x}$ above the efficient level. Specifically, the court sets $\overline{x} = x_c = 0.39063$, whereas the efficient level is $x^* = 0.36108$. This gives Globe the wrong incentives for efficient investment. Globe chooses x to maximize its expected profit from the contract.[11] For $x < x_c$, Globe's expected profit is

$$\begin{aligned} &\left[\$1150\sqrt{x} - \$100\left(1 - \sqrt{x}\right) - \$250\right]\left(1 - \exp\left[-\frac{\$633.39}{\$200}\right]\right) \\ &\qquad + \$383.39\left(\exp\left[-\frac{\$633.39}{\$200}\right]\right) - \$1000x, \end{aligned}$$

[11] In calculating Globe's expected profit, we assume that Globe believes (and believes that Landa believes) that the court takes the contract perspective in setting expectation damages, $D = D_r = \$383.39$.

which achieves a maximum value of \$39.33 at $x = 0.35841 < x^*$. For $x \geq x_c$, Globe's expected profit is

$$\left[\$1150\sqrt{x} - \$250\right]\left(1 - \exp\left[-\frac{\$633.39}{\$200}\right]\right) + \$383.39\left(\exp\left[-\frac{\$633.39}{\$200}\right]\right) - \$1000x,$$

which achieves a maximum value of \$74.52 at $x = x_c > x^*$. Globe will therefore overinvest, conforming to the (inefficiently high) due care standard $\overline{x} = x_c > x^*$.

3 General Analysis

We now consider the dual investment problem in a more general setup. Our model combines aspects of the standard contract model (see, e.g., Shavell 1980a; Miceli 1997, ch. 4) and the standard tort model (see, e.g., Shavell 1980b; Shavell 1987, ch. 2; Miceli 1997, ch. 2).

3.1 The Model

A buyer enters into a contract with a seller pursuant to which the seller agrees to produce and sell to the buyer, and the buyer agrees to buy from the seller, a good at the market price $P > 0$ which is payable upon delivery.[12] The buyer and seller are both expected value maximizers. Upon delivery the buyer will use the good in a risky activity that has the potential to benefit the buyer but also has the potential to harm a third party.[13]

The seller's production cost $Y > 0$ is uncertain at the time the contract is made but is realized before delivery is due. We assume Y has a strictly increasing and absolutely continuous distribution $F(y)$. Although the distribution $F(y)$ is common knowledge, the realization of the seller's production cost Y is the seller's private information. Once her production cost is realized, the seller decides whether to perform or breach the contract. If the seller breaches she will be liable to pay expectation damages D to the buyer.[14] Accordingly, the seller breaches if and only if the loss she would incur from performing exceeds the damages she would pay from breaching, i.e., if and only if $Y - P > D$.

After the contract is made, but before the seller realizes her production cost and makes her breach decision, the buyer has the opportunity to make an investment $x \in X \subseteq \mathbb{R}_+$ at cost $k(x) > 0$ that both increases the expected value of the contract to the buyer (a reliance investment) and reduces the expected harm to the third party (a care investment). We assume that the dual investment x is non-salvageable in the event the seller breaches the

[12]The good could be a tangible or intangible product or service.

[13]The buyer and the third party are strangers and not in a contractual relationship. Moreover, transaction costs are sufficiently high to preclude Coasean bargaining.

[14]We assume throughout that litigation is costless and error-free.

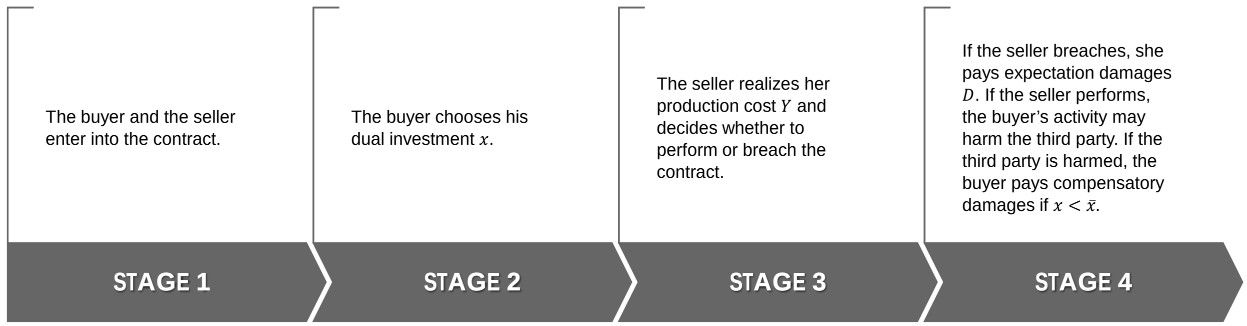

Figure 1: Timeline of the model.

contract. We further assume that the investment cost function $k(x)$ is twice continuously differentiable, strictly increasing, and convex—$k'(x) > 0$ and $k''(x) \geq 0$. Thus, investment cost increases with investment level at a non-decreasing rate.

Let $V(x) > 0$ denote the expected value of the good to the buyer and $H(x) > 0$ denote the expected harm to the third party. We assume $V(x)$ and $H(x)$ are common knowledge and $V(x) - H(x) > P$ for all $x \in X$. Hence, there is no uncertainty regarding the buyer's performance of the contract; the buyer will pay the contract price if the seller delivers the good. Moreover, it is efficient for the buyer to engage in his activity; the expected social value of the buyer's activity is positive. We further assume $V(x)$ is twice continuously differentiable, strictly increasing, and strictly concave—$V'(x) > 0$ and $V''(x) < 0$—and $H(x)$ is twice continuously differentiable, strictly decreasing, and strictly convex—$H'(x) < 0$ and $H''(x) > 0$. Thus, investment increases the expected value of the good and decreases its expected harm, in each case at a decreasing rate.[15]

If the contract is performed and the third party is subsequently harmed, the buyer will be liable to pay compensatory damages to the third party unless the buyer's investment x equals or exceeds the legal standard of due care $\overline{x} \in X$ set by the court.[16] We assume that damages are fully compensatory (i.e., equal to the third party's harm).[17]

Figure 1 recaps the sequence of events.

3.2 The Dual Perspective

From the dual perspective—which takes into account both the risk that the seller will breach the contract and the risk that, given performance, the buyer's use of the good will harm the

[15]We are assuming that the buyer, but not the third party, can take care to reduce the expected harm to the third party. We consider the case of bilateral care in section 4.2.

[16]That is, we are assuming that negligence is the governing tort liability rule. We consider the case of strict liability in section 4.1.

[17]In section 4.3 we consider the case where the buyer is only liable for harm caused by his negligence.

third party—the social problem is to choose a threshold production cost $t > 0$ (below which the seller produces the good and performs the contract and above which she does not produce the good and breaches the contract) and a dual investment x that maximize social welfare:

$$\max_{t>0, x\in X} \; F(t)[V(x) - H(x)] - \int_0^t y dF(y) - k(x).$$

The expected social value of the good, $V(x) - H(x)$, is realized with probability $F(t)$ (i.e., the probability that the good's production cost falls below the threshold t). From this we subtract the good's expected production cost conditional on production (the integral term) and the dual investment cost $k(x)$.

The first-order conditions that define the socially optimal levels t^* and x^* are

$$V(x^*) - H(x^*) = t^*; \tag{1}$$

$$F(t^*)[V'(x^*) - H'(x^*)] = k'(x^*). \tag{2}$$

Equation (1) states that the socially optimal production cost threshold equals the expected social value of the good given the socially optimal dual investment. Equation (2) states that the socially optimal dual investment equates the marginal cost of investment with the expected marginal benefit given the socially optimal production cost threshold. The expected marginal benefit of the dual investment is the product of the probability of performance and the marginal benefit conditional on performance, where the latter comprises the change in the expected social value of the good.

In what follows we show that if expectation damages are set equal to the expected social value of the good given the socially optimal dual investment minus the contract price,

$$D = D^* \equiv V(x^*) - H(x^*) - P,$$

and the due care standard is set equal to the socially optimal dual investment, $\overline{x} = x^*$, then the seller has the correct incentives for efficient breach and the buyer has the correct incentives for efficient investment. We use backward induction to solve for the equilibrium behavior of the parties. The relevant stages are stage 3, when the seller makes her breach decision, and stage 2, when the buyer makes his investment decision.

At stage 3, the seller performs the contract provided that the loss from performing does not exceed the damages for breach (i.e., $Y - P \leq D$) and breaches otherwise (i.e., $Y - P > D$). Equivalently, the seller performs if $Y \leq P + D$ and breaches if $Y > P + D$. This implies a performance probability of $F(P + D)$ and a breach probability of $1 - F(P + D)$.

The buyer's dual investment x is a sunk cost at this stage. It therefore is efficient for the seller to breach the contract if and only if her production cost exceeds the expected social value of the good, i.e., if and only if $Y > V(x) - H(x)$. It follows that expectation damages of $D = V(x) - H(x) - P$ induce efficient breach by the seller, because the seller breaches if and only if $Y > P + D = P + V(x) - H(x) - P = V(x) - H(x)$. This yields our first result.

Result 1 *Given the buyer's dual investment x, expectation damages of $D = V(x) - H(x) - P$ induces efficient breach by the seller.*

At stage 2, the contract will be performed with probability $F(P + D)$. The buyer will be liable to pay compensatory damages D to the third party if and only if he fails to meet the legal standard of due care $\overline{x}$. Hence the buyer's problem is

$$\max_{x \in X} \begin{cases} F(P+D)[V(x) - P] + [1 - F(P+D)]D - k(x) & \text{if} \quad x \geq \overline{x} \\ F(P+D)[V(x) - H(x) - P] + [1 - F(P+D)]D - k(x) & \text{if} \quad x < \overline{x} \end{cases}. \tag{3}$$

Using $D = D^*$, $F(P + D^*) = F(V(x^*) - H(x^*)) = F(t^*)$, and $\overline{x} = x^*$, we can state the buyer's problem as

$$\max_{x \in X} \begin{cases} F(t^*)[V(x) - P] + [1 - F(t^*)]D^* - k(x) & \text{if} \quad x \geq x^* \\ F(t^*)[V(x) - H(x) - P] + [1 - F(t^*)]D^* - k(x) & \text{if} \quad x < x^* \end{cases}. \tag{4}$$

Three observations establish that the solution to the buyer's problem is $x = x^*$.

1. The bottom expression in problem (4) achieves its *unconstrained* maximum at $x = x^*$.

   - To see this, take the first-order condition, $F(t^*)[V'(x) - H'(x)] = k'(x)$, and note that it is identical to equation (2).

2. The top expression in problem (4) achieves its *constrained* maximum at $x = x^*$.

   - We know this because it achieves its unconstrained maximum at $x < x^*$, which implies that it is decreasing in x for all $x \geq x^*$. To see this, take the first-order condition, $F(t^*)V'(x) = k'(x)$, and note that $V'(x) < V'(x) - H'(x)$.

3. The top expression exceeds the bottom expression for all $x \in X$, including at $x = x^*$.

   - This is because the top expression excludes the expected harm to the third party, $F(t^*)H(x) > 0$, which reflects that the buyer is insulated from potential liability to the third party when he takes due care $x \geq \overline{x} = x^*$.

Figure 2 illustrates the buyer's problem and its solution.

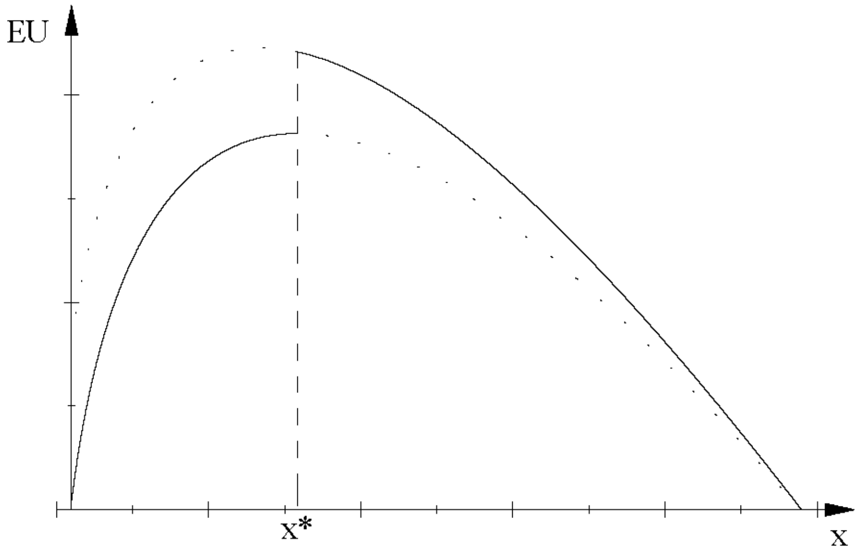

Figure 2: The buyer's expected utility under negligence with $\overline{x} = x^*$.

The foregoing analysis yields our second result.

Result 2 *Setting expectation damages equal to* $D = D^* \equiv V(x^*) - H(x^*) - P$ *and the due care standard equal to* $\overline{x} = x^*$ *induces efficient investment by the buyer.*

Together, results 1 and 2 establish our third result.

Result 3 *Setting* $D = D^* \equiv V(x^*) - H(x^*) - P$ *and* $\overline{x} = x^*$ *gives the seller the correct incentives for efficient breach and the buyer the correct incentives for efficient investment.*

3.3 The Contract and Tort Perspectives

We now show that if the court takes the contract perspective in calculating efficient reliance and setting expectation damages, and takes the tort perspective in calculating efficient care and setting the due care standard, this gives the seller the wrong incentives for efficient breach and the buyer the wrong incentives for efficient investment.

3.3.1 Contract Perspective

From the contract perspective—which takes into account the risk of breach but not the (post-performance) risk of external harm—expectation damages equal the expected value of the good to the buyer given efficient reliance x_r,[18]

$$D = D_r \equiv V(x_r) - P,$$

[18] We are assuming expectation damages as limited by the rule of Hadley v. Baxendale. See supra note 7.

where x_r is the solution to

$$\max_{x\in X}\ F(V(x))V(x)-\int_0^{V(x)} ydF(y)-k(x)$$

and is defined by the first-order condition

$$F(V(x_r))V'(x_r)=k'(x_r). \tag{5}$$

Comparing equation (5) and the joint implication of equations (1) and (2),

$$F(V(x^*)-H(x^*))[V'(x^*)-H'(x^*)]=k'(x^*), \tag{6}$$

we can see that efficient reliance from the contract perspective, x_r, can be less than, equal to, or greater than the socially optimal dual investment, x^*, depending on the specifications of $F(y)$, $V(x)$, $H(x)$, and $k(x)$. The expected marginal benefit of investment (i.e., the left-hand side of conditions (5) and (6)) is the product of the probability of performance and the marginal benefit of investment conditional on performance. If $x_r \geq x^*$ then the probability of performance is higher from the contract perspective than it is from the dual perspective, $F(V(x_r)) > F(V(x^*)-H(x^*))$, and the marginal benefit of investment conditional on performance is lower from the contract perspective than it is from the dual perspective, $V'(x_r) < V'(x^*)-H'(x^*)$. If $x_r < x^*$ then neither the probabilities of performance nor the marginal benefits of investment conditional on performance can be unambiguously ranked.

Remark With more structure, we can specify conditions for the ordering of x_r and x^*. Take, for instance, the structure of the example in section 2. There, $F(y)=1-e^{-\lambda y}$, $V(x)=b\pi(x)$ and $H(x)=h(1-\pi(x))$ (where $\pi(x)>\frac{1}{2}$, $\pi'(x)>0$, and $\pi''(x)<0$), and $k(x)=mx$. If b is large relative to λ and h, then the probabilities of performance from the contract and dual perspectives are approximately equal, $F(V(x_r))\approx F(V(x^*)-H(x^*))$, which implies that the marginal benefits of investment conditional on performance are approximately equal, $V'(x_r)=b\pi'(x_r)\approx m\approx(b+h)\pi'(x^*)=V'(x^*)-H'(x^*)$, and hence $x_r<x^*$ because $h>0$.

Consequently, expectation damages from the contract perspective, D_r, can be less than, equal to, or greater than the socially optimal level, D^*. In particular, if $x_r \geq x^*$ then $V(x_r)>V(x^*)-H(x^*)$, in which case

$$D_r \equiv V(x_r)-P > V(x^*)-H(x^*)-P \equiv D^*.$$

If however $x_r < x^*$ then $D_r \leq D^*$ or $D_r > D^*$ is possible, though if $D_r \leq D^*$ then $x_r < x^*$. In other words, $D_r \leq D^*$ is consistent only with $x_r < x^*$, whereas $D_r > D^*$ is consistent with either $x_r < x^*$ or $x_r \geq x^*$.

The seller's breach condition is $Y > P + D_r = V(x_r)$, whereas the efficient breach condition is $Y > V(x^*) - H(x^*) = P + D^*$. Accordingly, if $D_r < D^*$ then there will be cases in which the seller will breach when it would be efficient to perform, namely when

$$V(x_r) = P + D_r < Y < P + D^* = V(x^*) - H(x^*).$$

Conversely, if $D_r > D^*$ then there will be cases in which the seller will perform when it would be efficient to breach, namely when

$$P + D^* = V(x^*) - H(x^*) < Y < V(x_r) = P + D_r.$$

Only in the knife-edge case where $D_r = D^*$ (which will occur only for a singular $x_r < x^*$) will the seller breach only when it is efficient to do so.

This yields our fourth result.

Result 4 *Assume the court takes the contract perspective in calculating efficient reliance x_r and setting expectation damages $D = D_r \equiv V(x_r) - P$. If $D_r < D^*$ then the seller will breach too frequently, in particular when $P + D_r < Y < P + D^*$. If $D_r > D^*$ then the seller will breach too infrequently, in particular failing to breach when $P + D^* < Y < P + D_r$. Only in the knife-edge case where $D_r = D^*$ will the seller breach only when it is efficient to do so.*

3.3.2 Tort Perspective

From the tort perspective—which takes into account the risk of external harm but not the (pre-performance) risk of breach—due care corresponds to efficient care, $\overline{x} = x_c$, where x_c is the solution to

$$\max_{x \in X} \; V(x) - H(x) - k(x)$$

and is defined by the first-order condition

$$V'(x_c) - H'(x_c) = k'(x_c). \tag{7}$$

Comparing equation (7) with equation (2), we have that $x_c > x^*$ because $F(t^*) < 1$. Furthermore, comparing equation (7) with equation (5), we have that $x_c > x_r$ because $F(V(x_r)) < 1$ and $H'(x) < 0$.

Result 5 *Assume the court takes the tort perspective in calculating efficient care* x_c*. Then* $x_c > x^*$ *and the court sets the due care standard above the efficient level,* $\overline{x} = x_c > x^*$*. Moreover, efficient care from the tort perspective exceeds efficient reliance from the contract perspective,* $x_c > x_r$*.*

Setting $\overline{x} = x_c > x^*$ generally gives the buyer the wrong incentives for efficient investment. In particular, as we explain below, if $D_r < D^*$ then the buyer will either overinvest (i.e., choose $x > x^*$) or underinvest (i.e., choose $x < x^*$), and if $D_r > D^*$ then the buyer will overinvest. Even in the knife-edge case where $D_r = D^*$ the buyer may or may not invest efficiently (i.e., choose $x = x^*$); specifically, he will either invest efficiently or overinvest.

The buyer chooses his investment level x to maximize his expected profit from the contract. Set $D = D_r$ and $\overline{x} = x_c > x^*$. Then the buyer's problem is

$$\max_{x \in X} \begin{cases} F(P + D_r)[V(x) - P] + [1 - F(P + D_r)]D_r - k(x) & \text{if} \quad x \geq x_c \\ F(P + D_r)[V(x) - H(x) - P] + [1 - F(P + D_r)]D_r - k(x) & \text{if} \quad x < x_c \end{cases}. \tag{8}$$

Because we reference them below, let us derive the *unconstrained* first-order conditions for the top and bottom expressions in problem (8):

$$F(P + D_r)V'(x) = k'(x); \tag{9}$$

$$F(P + D_r)[V'(x) - H'(x)] = k'(x). \tag{10}$$

Observe that equation (9) is equivalent to equation (5) because $P + D_r = V(x_r)$; hence, the top expression achieves its unconstrained maximum at $x = x_r < x_c$. Furthermore, note that the equation (10) is identical to equation (2) except that the probability of performance is $F(P + D_r)$ instead of $F(P + D^*)$; thus, the ranking of the unconstrained maximizer of the bottom expression and the efficient investment x^* depends on the ranking of D_r and D^*.

Assume first that $D_r \leq D^*$, which implies $x_r < x^*$. Two implications follow:

1. The top expression in problem (8) achieves its *constrained* maximum at $x = x_c > x^*$.

   - To see this, recall that x_r is the unconstrained maximizer of the top expression and that $D_r \leq D^*$ implies $x_r < x^*$. By result 5, we have that $x_r < x^* < x_c$, which implies that the top expression is decreasing in x for all $x \geq x_c$.

2. The bottom expression in (8) achieves its *constrained* maximum at some $x \leq x^*$ (with $x = x^*$ if and only if $D_r = D^*$).

   - We know this because the bottom expression achieves its unconstrained maximum at $x \leq x^*$ (with $x = x^*$ if and only if $D_r = D^*$). To see this, compare equations

(2) and (10) and note that $D_r \le D^*$ implies $F(P + D_r) \le F(P + D^*) = F(t^*)$ (where $F(P + D_r) = F(P + D^*)$ if and only if $D_r = D^*$).

It follows that when $D_r \le D^*$ the solution to the buyer's problem is either (i) the point $x = x_c > x^*$ at which the top expression achieves its constrained maximum or (ii) the point $x \le x^*$ at which the bottom expression achieves its constrained maximum (with $x = x^*$ if and only if $D_r = D^*$), whichever gives the buyer greater expected profit. Thus, when $D_r < D^*$ the buyer will either overinvest or underinvest, and when $D_r = D^*$ he will either overinvest or invest efficiently.

Assume next that $D_r > D^*$, which implies that $x_r < x^* < x_c$ or $x^* \le x_r < x_c$. Then:

1. The top expression in problem (8) achieves its *constrained* maximum at $x = x_c > x^*$.

   - To see this, recall that x_r is the unconstrained maximizer of the top expression and that $D_r > D^*$ implies either $x_r < x^* < x_c$ or $x^* < x_r < x_c$. Either way, it follows that the top expression achieves its constrained maximum at $x = x_c > x^*$.

2. The bottom expression in (8) achieves its *constrained* maximum at some $x \in (x^*, x_c)$.

   - We know this because the bottom expression achieves its unconstrained maximum at $x > x^*$. To see this, compare equations (2) and (10) and note that $D_r > D^*$ implies $F(P + D_r) > F(P + D^*) = F(t^*)$.

It follows that when $D_r > D^*$ the buyer's expected profit is maximized at a point $x > x^*$. That is, when $D_r > D^*$ the buyer will overinvest.

Our sixth result recaps the foregoing.

Result 6 *Assume the court takes the contract perspective in calculating efficient reliance and setting expectation damages and takes the tort perspective in calculating efficient care and setting the due care standard. Then the buyer generally will not choose the socially optimal dual investment. If $D_r < D^*$ then the buyer will either overinvest or underinvest. If $D_r > D^*$ then the buyer will overinvest. Even in the knife-edge case where $D_r = D^*$ the buyer may or may not invest efficiently; he will either invest efficiently or overinvest.*

3.4 Recap

To summarize our results:

- Were a court to take the dual perspective, it would set expected damages and the due care standard equal to their socially optimal levels, providing correct incentives for efficient breach by the seller and for efficient investment by the buyer. [Results 1–3]

Table 1: Summary of Results

	Dual perspective	Contract and tort perspectives
Efficient reliance	x^*	$x_r \lesseqqgtr x^*$
Expectation damages	$D^* = V(x^*) - H(x^*) - P$	$D_r = V(x_r) - P$ $x_r \geq x^* \Rightarrow D_r > D^*$ $x_r < x^* \Rightarrow D_r \leq D^*$ or $D_r > D^*$
Efficient care	x^*	$x_c > x^*$ and $x_c > x_r$
Due care standard	$\overline{x} = x^*$	$\overline{x} = x_c > x^*$
Seller behavior	Efficient breach	$D_r < D^* \Rightarrow$ breach too frequently $D_r = D^* \Rightarrow$ efficient breach $D_r > D^* \Rightarrow$ breach too infrequently
Buyer behavior	Efficient investment	$D_r < D^* \Rightarrow$ overinvest or underinvest $D_r = D^* \Rightarrow$ overinvest or invest efficiently $D_r > D^* \Rightarrow$ overinvest

- Generally, however, if the court takes the contract perspective in setting expectation damages and the tort perspective in setting the due care standard, they will not equal their socially optimal levels, with expectation damages being sub- or supraoptimal and the due care standard being supraoptimal, and consequently the seller will breach too frequently or infrequently and the buyer will over- or underinvest. [Results 4–6]

Table 1 recaps the details.

4 Extensions

Our analysis in section 3 is based on a model which assumes, *inter alia*, that: (i) the buyer is liable for third-party harm only if he is negligent; (ii) the buyer, but not the third party, can take care against harm; and (iii) if the buyer is negligent, then he is liable for any and all third-party harm. In this section we consider extensions of the model in which we modify the foregoing assumptions. As we shall see, none of these extensions changes the main message, though some serve to simplify the analysis.[19]

[19] The model also assumes that (A) there is uncertainty about the seller's performance of the contract, but not about the buyer's performance, and (B) the contract does not provide for liquidated damages. In the appendix we consider extensions in which we modify these assumptions.

4.1 Strict Liability

Our model assumes that negligence is the governing tort liability rule. If the buyer will be held strictly liable for external harm, then no assessment of due care is required, and hence whether the court takes the tort perspective is inconsequential. Under strict liability, therefore, any inefficiencies will arise solely from the court taking the contract perspective.

Set $D = D_r$ and assume that strict liability is the governing tort liability rule. The analysis with respect to the seller, including in particular result 4, remains unchanged. Assuming strict liability, however, changes the analysis with respect to the buyer.

The buyer's problem under strict liability is

$$\max_{x \in X} \; F(P + D_r)[V(x) - H(x) - P] + [1 - F(P + D_r)]D_r - k(x).$$

The solution is defined by the first-order condition

$$F(P + D_r)[V'(x) - H'(x)] = k'(x). \tag{11}$$

As the left-hand side indicates, the buyer now internalizes the full expected marginal social benefit of his investment. If $D_r = D^*$ then $F(P + D_r) = F(t^*)$ (by the definition of D^* and equation (1)) and thus equation (11) coincides with equation (2). It follows that the buyer will choose the socially optimal investment $x = x^*$ if expectation damages coincidentally are efficient, $D_r = D^*$, but that he will overinvest $x > x^*$ if $D_r > D^*$ and underinvest $x < x^*$ if $D_r < D^*$ (in each case because $V''(x) - H''(x) < 0$ and $k''(x) \geq 0$).

4.2 Bilateral Care

Our analysis assumes that only the buyer can take care to reduce the expected harm to the third party. In many circumstances, however, the third party can invest in care as well.

Suppose that expected harm $H(x, z)$ is now a function of separate investments made by the buyer and the third party, where the third party's investment is $z \in Z \subseteq \mathbb{R}_+$ and has a cost $l(z)$ that increases with the investment level at a non-decreasing rate. We assume that each investment decreases expected harm at a decreasing rate. We further assume that the cross-partial derivative of $H(x, z)$ is positive, implying that x and z are substitute inputs in the reduction of expected harm (see, e.g., Miceli 1997, ch. 2).

Socially optimal levels are the solution to

$$\max_{t>0, x \in X, z \in Z} \; F(t)[V(x) - H(x, z)] - \int_0^t y dF(y) - k(x) - l(z),$$

as we assume that the third party (like the buyer) makes their investment decision before the seller makes her breach decision. The social optimum is defined by analogues of conditions (1) and (2) plus the following additional condition:

$$-F(t^*)\frac{\partial H(x^*, z^*)}{\partial z} = l'(z^*).$$

If the court takes the dual perspective and sets $D = D^*$ and $\overline{x} = x^*$, this gives the buyer and the third party correct incentives for efficient investment.[20] If however the court takes the contract and tort perspectives and sets $D = D_r$ and $\overline{x} > x^*$, then the buyer generally will choose $x \neq x^*$, which distorts the third party's incentives. For any D and x, the third party's incentives (assuming the buyer takes due care) are described by the first-order condition

$$-F(P + D)\frac{\partial H(x, \tilde{z})}{\partial z} = l'(\tilde{z}),$$

and thus $\tilde{z} \neq z^*$ unless both $D_r = D^*$ (in which case $P + D = t^*$) and $x = x^*$ hold.

In general, the court's failure to take the dual perspective will induce inefficient behavior not only by the contracting parties but also by external parties.

4.3 Causation

As is standard in the literature, our specification of the buyer's problem under the negligence rule assumes that if the buyer is negligent, then he is liable for any and all external harm caused by his activity. As a matter of common law, however, an injurer is only liable for harm caused by his negligence (see, e.g., Grady 1983; Kahan 1989). Under this negligence representation, the buyer's problem can be stated as

$$\max_{x \in X} \begin{cases} F(P + D)[V(x) - P] + [1 - F(P + D)]D - k(x) & \text{if} \quad x \geq \overline{x} \\ F(P + D)[V(x) - (H(x) - H(\overline{x})) - P] + [1 - F(P + D)]D - k(x) & \text{if} \quad x < \overline{x} \end{cases}. \tag{12}$$

If the court takes the dual perspective and sets $D = D^*$ and $\overline{x} = x^*$, then problem (12) reduces to problem (4),[21] and hence result 3 is unchanged. As we explain below, however, if the court takes the contract and tort perspectives and sets $D = D_r$ and $\overline{x} = x_c > x^*$, then our conclusions regarding the buyer's investment decisions set forth in result 6 are simplified by the fact that we now can exclude the possibility that the buyer will choose $x = x_c$.

If the court sets $D = D_r$ and $\overline{x} = x_c$, then conditions (9) and (10) describe the marginal incentives for the top and bottom expressions in problem (12). This implies that much of

[20] As in section 2, we are assuming that the buyer cannot assert the defense that the third party was contributorily negligent. The court therefore sets a due care standard for the buyer but not the third party.

[21] Note that the term $H(\overline{x})$, which becomes $H(x^*)$, is a constant and so does not affect the solution.

result 6 remains intact. However, the result is simplified by the fact that we now can exclude the possibility that the buyer will comply with the due care standard (which contrasts with our analysis in section 3.3.2, where the payoff discontinuity in problem (8) allowed for $x = x_c$ as an equilibrium outcome). Assume $\tilde{x}$ solves condition (10). This implies

$$F(P + D_r)(V(x_c) - H(x_c) - P) - k(x_c) < F(P + D_r)[V(\tilde{x}) - H(\tilde{x}) - P] - k(\tilde{x}).$$

This in turn implies that a comparison of the maximized top expression conditional on $x \geq x_c$ with the maximal bottom expression yields the following ranking:

$$\begin{aligned} &F(P + D_r)(V(x_c) - P) + (1 - F(P + D_r))D_r - k(x_c) \\ &\qquad < F(P + D_r)[V(\tilde{x}) - (H(\tilde{x}) - H(x_c)) - P] + [1 - F(P + D_r)]D_r - k(\tilde{x}). \end{aligned}$$

In other words, the buyer will always choose to take less than due care, $x < x_c$. In particular, he will choose $x \leq x^* < x_c$ if $D_r \leq D^*$ (with $x = x^*$ if and only if $D_r = D^*$) and $x \in (x^*, x_c)$ if $D_r > D^*$. That is, the buyer will now underinvest if $D_r < D^*$, invest efficiently if $D_r = D^*$, and overinvest if $D_r > D^*$.

5 Discussion

We study situations in which a single investment both increases the value of a contract and reduces the risk of a tort. We show that if courts in ensuing contract and tort cases account for the dual nature of the investment, then contract and tort law will provide efficient incentives. However, the law generally will not provide efficient incentives if courts fail to account for the duality of the investment, and instead take a narrow contract or tort perspective, as the case may be, instantiating the doctrinal separation between contract and tort.

It is important to emphasize that we are not arguing that contract or tort law precludes courts from accounting for the dual nature of the investment. It is basic contract law that "[a] contracting party is generally expected to take account of those risks that are foreseeable at the time he makes the contract."[22] Hence, a court presumably may account for the foreseeable risk of a (post-performance) tortious accident in determining expectation damages for breach of contract. And it is basic tort law that "[a] person acts negligently if the person does not exercise reasonable care under all of the circumstances."[23] It stands to reason that "all the circumstances" would include the risk of a (pre-accident) contractual breach, and thus a court presumably may account for such risk in determining the due

[22]Restatement (Second) of Contracts § 351 (1981).

[23]Restatement (Third) of Torts: Liability for Physical and Emotional Harm § 3 (2010).

care standard for negligence. Rather, we are making a behavioral assumption about courts, namely that they often may fail to take the dual perspective in dual investment situations.

We are also making an important assumption about the parties, namely that they are price takers who do not bargain over the price of the good.[24] In the appendix we show that if the parties can bargain over the price (and other terms), then they can bargain to the efficient solution—achieved through a price adjustment in exchange for liquidated damages—provided that (i) strict liability is the governing tort liability rule and (ii) the court would enforce the liquidated damages provision.[25] We think this is cold comfort, however, for three reasons. First, the parties often are price takers. Second, as we also show in the appendix,[26] the result does not generally hold under negligence—and negligence is the usual rule, while strict liability is the exception.[27] Third, the court in many cases would not enforce the liquidates damages provision, because the buyer's damages are often easily ascertainable.[28]

To our knowledge, this paper is the first in the law and economics literature to consider the scenario in which an investment in care against a tort also serves as an investment in reliance on a contract. As such, we believe it makes novel contributions to the well-established strands of the literature that study optimal tort liability rules (e.g., Shavell 1980b; Teitelbaum 2007) and contract breach remedies (e.g., Shavell 1980a; Cooter and Eisenberg 1985).

A key takeaway of the paper is that courts in dual investment cases should take the dual perspective, which unifies the standard economic approaches to contract and tort problems. Cooter (1985) was the first to illuminate the idea that contract and tort problems can be analyzed through a unitary economic framework—the precaution model—in which parties can make investments to reduce expected harms.[29] In the tort context the injurer and the victim "can take precautions to reduce the frequency or destructiveness of accidents," while in the contract context "the promisor can take steps to avoid breach, and the promisee, by placing less reliance on the promise, can reduce the harm caused by the promisor's breach" (Cooter 1985, p. 3). We leverage this insight. Miceli (2014) also leverages this insight, to offer an economic account of the doctrinal boundary between contract and tort.[30] In his

[24]This assumption is implicit in the statement that P is the market price of the good; see section 3.1.

[25]See appendix section B.1.

[26]See appendix section B.2.

[27]In modern Anglo-American tort law, strict liability applies only in a handful of cases, including cases involving abnormally dangerous activities or products with manufacturing defects (Dobbs et al. 2011, § 2). Indeed, certain cases that were traditionally governed by strict liability are now governed by negligence, including cases involving products with a design or warning defect (Dobbs et al. 2011, § 450).

[28]A liquidated damages provision is unenforceable if (i) the actual damages are easily ascertainable or (ii) the liquidated damages do not bear a reasonable proportion to the probable actual damages. See, e.g., Truck Rent-a-Center, Inc. v. Puritan Farms 2nd, Inc., 41 N.Y.2d 420 (1977); Quaker Oats Co. v. Reilly, 711 N.Y.S.2d 498 (App. Div. 2000). Courts often strike liquidated damages provisions due to the first prong. See, e.g., Motichka v. Cody, 773 N.Y.S.2d 46 (App. Div. 2004).

[29]See also Cooter and Porat (2014, ch. 6). Cooter (1985) applies the framework to property as well.

[30]Miceli's (2014) account also extends to property and its boundaries with contract and tort.

account, the doctrinal boundary is explained by differences in the economic nature of the problems that characterize contract and tort cases. By contrast, we study problems that by their economic nature cut across the doctrinal boundary between contract and tort.

The idea that care investments may have effects besides reducing the risk of external harm has been considered before. For example, Cooter and Porat (2000) highlight that taking care often reduces the risk of harm to oneself as well as the risk of harm to others. They argue that courts should reconceptualize the Hand Rule so that risk to oneself increases the care owed to others. Dharmapala and Hoffmann (2005) consider scenarios in which the care taken by one party affects both expected harm and the other party's cost of care. They show how this interdependence reduces the circumstances under which standard liability rules induce efficient behavior. Porat (2007) observes that care often reduces one type of risk while increasing another (e.g., prescribing drugs that lower the risk of disease while carrying the risk of side effects). He argues that efficiency is best served when the respective risk effects are netted out. Friehe (2012) compares the performance of liability rules in cases where one potential victim's care affects not only the level of expected harm but also the probability that the accident risk can be diverted to other potential victims (e.g., when a hillside resident erects protection against flooding).[31] Baumann and Friehe (2016) examine how care-taking can influence expected harm and also generate information about which accident technology applies in a specific setting. Luppi et al. (2016) consider activities (e.g., driving) in which (i) there is "role uncertainty" in that people may end up being an injurer or a victim and (ii) there are "dual-effect precautions" (e.g., headlights) which reduce both the probability of being an injurer and the probability of being a victim. They find that in these situations the traditional formulation of negligence fails to provide efficient incentives, and they argue for a modification of the due care standard that accounts for the full benefit of dual-effect precautions. We extend the foregoing line of research by studying cases where the dual purpose of the care investment is increasing the expected value of a contract.[32]

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[31] This topic of harm displacement was later revisited by Givati and Kaplan (2020).

[32] A related line of research considers the broad question of which aspects of the parties' care-taking behavior should be included in the court's liability analysis in light of information impediments and other administrative costs (see, e.g., Dari-Mattiacci 2005; Anderson 2007).

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Appendix

In this appendix we consider two additional extensions of our baseline model and analysis. In the first, we assume there is uncertainty about the buyer's performance of the contract. In the second, we consider the case where the contract provides for liquidated damages.

A Buyer's Performance is Uncertain

The baseline model considers the case in which the seller's performance of the contract is uncertain because her production cost is stochastic. We now consider the alternative case in which the buyer's performance is uncertain. In particular, suppose that the seller's production cost y is fixed but that the expected value of the contract to the buyer depends on the realization γ of a random variable $\Gamma > 0$ that has an absolutely continuous distribution $G(\gamma)$. (In the example in section 2, for instance, Γ could be the cost to Globe of refining one tank of crude oil.) We assume that $V(x,\gamma)$ is higher at lower values of γ and that the marginal value of investment is lower at higher values of γ. (In the example in section 2, the expected value of the contract is higher when refining costs are lower, but the marginal value of investing in a thicker shell is lower when refining costs are higher.) We further assume that the buyer chooses his dual investment x before γ is realized and he decides whether to perform or breach the contract.

The social problem from the dual perspective is

$$\max_{\tau>0, x\in X} \int_0^{\tau} [V(x,\gamma) - H(x)]dG(\gamma) - G(\tau)y - k(x),$$

where $\tau > 0$ is the critical value of Γ (below which the buyer performs the contract and above which he breaches the contract). The first-order conditions that define the socially optimal levels τ^* and x^* are

$$V(x^*,\tau^*) - H(x^*) = y; \tag{A1}$$

$$\int_0^{\tau^*} \left[\frac{\partial V(x^*,\gamma)}{\partial x} - H'(x^*)\right] dG(\gamma) = k'(x^*). \tag{A2}$$

From the contract perspective, expectation damages equal the value of the contract to the seller, $D = P - y$, and hence are independent of the buyer's dual investment x. Any inefficiencies, therefore, will arise solely from the court taking the tort perspective. To see this, suppose that strict liability were the governing tort liability rule. The buyer's problem under strict liability is

$$\max_{\tau>0, x\in X} \int_0^{\tau} [V(x,\gamma) - H(x) - P]dG(\gamma) + [1 - G(\tau)](P - y) - k(x),$$

and the solution $(\tilde{\tau}, \tilde{x})$ is defined by the first-order conditions

$$V(\tilde{x},\tilde{\tau}) - H(\tilde{x}) = y; \tag{A3}$$

$$\int_0^{\tilde{\tau}} \left[\frac{\partial V(\tilde{x},\gamma)}{\partial x} - H'(\tilde{x})\right] dG(\gamma) = k'(\tilde{x}). \tag{A4}$$

Comparing conditions (A1)-(A2) and (A3)-(A4), we can see that the buyer would behave efficiently under strict liability, $(\tilde{\tau}, \tilde{x}) = (\tau^*, x^*)$.

Under negligence, however, this generally will not be the case. From the tort perspective, due care $\overline{x}$ is assessed after the realization of Γ and equals the solution to

$$\max_{x\in X} V(x,\check{\gamma}) - H(x) - k(x),$$

and is defined by the first-order condition

$$\frac{\partial V(\overline{x}, \check{\gamma})}{\partial x} - H'(\overline{x}) = k'(\overline{x}), \tag{A5}$$

where $\check{\gamma}$ is the buyer's realization of Γ (which was low enough to induce him to perform the contract). Comparing equations (A2) and (A5), we can see that $\overline{x} \neq x^*$ unless, by the luck of the draw, $\check{\gamma}$ is such that the left-hand sides of equations (A2) and (A5) happen to be equal. Note that the due care standard is lower at higher levels of γ since the marginal value of the investment is assumed to be lower at higher values of γ.

Because the buyer chooses his dual investment x before he learns the realization γ of the random variable Γ, the due care standard is a random variable from the buyer's perspective, with $\overline{x}(\gamma) \in \mathcal{S} = [\overline{x}(\tau), \overline{x}(0)]$. If the buyer chooses an investment level strictly inside $\mathcal{S}$, then there is a cost level $\overline{\gamma}(x) = \overline{x}^{-1}(x)$, $\overline{\gamma}'(x) < 0$, such that the buyer takes due care when $\gamma \geq \overline{\gamma}(x)$. With this understanding, we can state the buyer's problem as follows:

$$\max_{\tau>0, x\in X} \int_0^{\overline{\gamma}(x)} (V(x,\gamma) - H(x) - P) dG(\gamma) + \int_{\overline{\gamma}(x)}^{\tau} (V(x,\gamma) - P) dG(\gamma) - [1 - G(\tau)](P - y) - k(x).$$

The first term is the buyer's expected profit from the contract when he performs and the dual investment implemented before the draw of γ is lower than the ultimately relevant due care standard. The second term is the buyer's expected profit when he performs and the dual investment ultimately turns out to be weakly in excess of due care. The third term is the buyer's payment of expectation damages when he breaches the contract. The fourth term is the buyer's dual investment cost.

Assuming $\overline{\gamma}(x) \in (0, \tau)$, the first-order conditions with respect to τ and x are

$$\begin{aligned} & V(x,\tau) = y; \\ & \int_0^{\tau} \frac{\partial V(x,\gamma)}{\partial x} dG(\gamma) - \int_0^{\overline{\gamma}(x)} H'(x) dG(\gamma) - \overline{\gamma}'(x) H(x) g(\overline{\gamma}(x)) = k'(x), \end{aligned}$$

where $g(\gamma) = G'(\gamma)$. Relative to the social optimum [equations (A1)-(A2)], the buyer's investment incentives are weakened by the fact that he considers the marginal reduction in the expected harm to the third party only when he fails to take due care. However, the fact that investment reduces $\overline{\gamma}(x)$, and thereby increases the probability that the buyer takes due care, produces offsetting marginal benefits. Our argument is similar to the one about uncertain legal standards in Craswell and Calfee (1986), for example, with the distinction that the factor causing the randomness of the legal standard, γ, also directly influences the buyer's problem via the expected value of the contract. However, the conclusion by Craswell and Calfee (1986)—that behavior may exceed or fall short of the socially optimal level depending on the assumptions—also applies here.

B Liquidated Damages

In this section we show that if the parties can bargain over the price of the good (and the other terms of the contract), then they can bargain to the efficient solution—achieved through a price adjustment in exchange for liquidated damages equal to D^*—provided that (i) strict liability is the governing tort liability rule and (ii) the court would enforce the liquidated damages provision. We also show that the result does not generally hold under negligence (even assuming the court would enforce the liquidated damages provision).[33]

B.1 Strict Liability

Assume that strict liability is the governing tort liability rule. We know from section 4.1 that the buyer will choose the socially optimal investment if expectation damages are efficient, $D_r = D^*$, but that he will underinvest if $D_r < D^*$ and overinvest if $D_r > D^*$.

Case 1: $D_r < D^*$. Suppose the default is $D = D_r < D^*$ and $\tilde{x}(D) < x^*$, where $\tilde{x}(D)$ denotes the buyer's optimal investment given D. The buyer's expected payoff is

$$\Pi_B = F(P+D)[V(\tilde{x}(D)) - H(\tilde{x}(D)) - P] + [1 - F(P+D)]D - k(\tilde{x}(D)).$$

The seller's expected payoff is

$$\Pi_S = \int_0^{P+D} (P-y)dF(y) - [1 - F(P+D)]D,$$

which is independent of the buyer's investment. Marginally increasing D induces the following changes to the buyer's expected payoff and the seller's expected payoff, respectively:

$$\frac{\partial \Pi_B}{\partial D} = f(P+D)[V(\tilde{x}(D)) - H(\tilde{x}(D)) - P - D] + [1 - F(P+D)];$$
$$\frac{\partial \Pi_S}{\partial D} = -[1 - F(P+D)],$$

where we invoke the envelope theorem to disregard the indirect effect via $\tilde{x}$. Note that $V(\tilde{x}(D)) - H(\tilde{x}(D)) - P$ increases with D and equals $D^* = V(\tilde{x}(D^*)) - H(\tilde{x}(D^*)) - P$ when $D = D^*$. Hence, the buyer's gain from increasing D exceeds the seller's loss for all $D \leq D^*$. Thus, there exists a mutually beneficial bargain in which the parties agree to a price increase in exchange for the provision of liquidated damages equal to D^*.

[33]Intuitively, this is because although the parties can bargain for the efficient amount of damages for beach of contract, they cannot bargain for the efficient standard of due care.

Case 2: $D_r > D^*$**.** Now suppose the default is $D = D_r > D^*$ and $\tilde{x}(D) > x^*$. In this case, marginally decreasing D induces the following changes to parties' expected payoffs:

$$\frac{\partial \Pi_B}{\partial D} = -f(P+D)[V(\tilde{x}(D)) - H(\tilde{x}(D)) - P - D] - [1 - F(P+D)];$$
$$\frac{\partial \Pi_S}{\partial D} = [1 - F(P+D)].$$

Because $V(\tilde{x}(D)) - H(\tilde{x}(D)) - P < D$ when $D > D^*$, the seller's gain from decreasing D exceeds the buyer's loss for all $D \geq D^*$. Thus, there exists a mutually beneficial bargain in which the parties agree to a price decrease in exchange for the provision of liquidated damages equal to D^*.

We therefore have the following result:

Result A1 *Under strict liability, whether $D_r < D^*$ or $D_r > D^*$, if the parties can bargain over the price of the good (and the other terms of the contract), the parties can agree to a price adjustment in exchange for the provision of liquidated damages equal to the efficient level D^*, and thereby provide correct incentives for efficient breach and efficient investment.*

B.2 Negligence

Under negligence, the buyer escapes liability if his investment complies with the due care standard $\overline{x} = x_c$, where we know from section 3.3.2 that $x_c > x^*$. As explained in Shavell (1987, § 4A.3.4), for example, an injurer will comply with a due care standard that exceeds the efficient level if the benefit of escaping liability exceeds the additional investment cost. In accordance with this insight, the analysis in section 3.3.2 establishes that $D_r < D^*$ may induce either $\tilde{x} = x_c$ or $\tilde{x} < x^*$ and that $D_r > D^*$ may induce either $\tilde{x} = x_c$ or $\tilde{x} \in (x^*, x_c)$.

It follows that, under negligence, there are cases in which the parties can bargain for liquidated damages equal to D^* and the buyer will choose to invest x^*. For instance, this will occur when the default is $D_r > D^*$ and $\tilde{x} < x_c$. The logic in this case is comparable to the logic under strict liability.

In many cases, however, the parties cannot bargain to the efficient solution. Consider the cases in which (i) the default is $D_r < D^*$ and $\tilde{x} = x_c$ and (ii) the default is $D_r < D^*$ and $\tilde{x} < x_c$. In either case, if the parties bargain to increase damages (in exchange for a price increase), this strengthens the buyer's incentive to take due care (i.e., overinvest). Post bargaining, therefore, the buyer will continue to take due care in the former case and may choose to take due care in the latter case (if the benefit exceeds the cost).[34] Moreover, in

[34] A similar, but converse, logic applies to the case in which the default is $D_r > D^*$ and $\tilde{x} = x_c$. If the parties bargain to decrease damages (in exchange for a price decrease), this weakens the buyer's incentive to take due care, but he may nevertheless continue to take due care (if the benefit exceeds the cost).

either case, if the buyer will take due care, the parties will bargain for liquidated damages in excess of D^*.[35]

To summarize:

Result A2 *Under negligence, while there are cases where the parties can bargain for liquidated damages equal to D^* and the buyer will choose to invest x^*, in many cases the buyer's incentives to take due care will preclude the parties from bargaining to the efficient solution.*

[35] To see this, observe that marginally increasing damages D increases the buyer's expected payoff by $f(P+D)[V(x_c)-P-D]+[1-F(P+D)]$ and decreases the seller's expected payoff by $[1-F(P+D)]$. It follows that the buyer's gain from increasing D exceeds the seller's loss for all $D \leq V(x_c)-P$. Because $V(x_c)-P > D^*$, this implies that the parties will agree to increase D in excess of D^*.