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Breach Remedies Inducing Hybrid Investments

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Breach Remedies Inducing Hybrid Investments *

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Abstract

We show that parties in bilateral trade can rely on the default common law breach remedy of 'expectation damages' to induce simultaneously first-best relationship-specific investments of both the selfish and the cooperative kind. This can be achieved by writing a contract that specifies a sufficiently high quality level. In contrast, the result by Che and Chung (1999) that 'reliance damages' induce the first best in a setting of purely cooperative investments, does not generalize to the hybrid case. We also show that if the quality specified in the contract is too low, 'expectation damages' do not necessarily induce the ex-post efficient trade decision in the presence of cooperative investments.

Keywords: breach remedies, incomplete contracts, hybrid investments, cooperative investments, selfish investments.

JEL-Classification: K12, L22, J41, C70.

1 Introduction

A risk neutral buyer and seller contract for the future delivery of a good. Before delivery can take place, the seller makes an investment which has no value to the outside market but which decreases the seller's cost of production *and* increases the future value of the good to

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the buyer. That is, the investment is *hybrid*, combining cooperative investments in the sense of Che and Chung (1999) with selfish investments as traditionally analyzed in the literature (see e.g. Chung, 1991; Aghion, Dewatripont and Rey, 1994; Edlin and Reichelstein 1996; Shavell, 1980, 1984; Rogerson, 1984).[1]

These investments are highly relevant. Consider the famous General Motors - Fisher Body case, which deals with Fisher Body's decision to build a plant adjacent to General Motors. Such an arrangement offered benefits to both parties by lowering shipping costs *and* improving supply reliability (see Che and Hausch, 1999). Or consider the example of Marks & Spencer, which routinely organizes joint trips to trade shows with its suppliers. The trips enhance mutual understanding and help both parties to identify new products that they could develop cooperatively. By facilitating bilateral communication, Marks & Spencer adds valuable items to its product line while lowering the risk of costly reengineering of products for the suppliers (see Kumar, 1996).

In the absence of contractual protection, the parties negotiate the terms of trade after investments are sunk and after the quality of the product is revealed. Unless the investing party has all the bargaining power, that party can only internalize a fraction of the investment benefit in such negotiations. Recognizing this potential for hold-up, the seller invests less than is socially desirable (Williamson, 1979, 1985; Grout, 1984; Grossman and Hart, 1986; Hart and Moore, 1988).

We develop a model where parties write a contract specifying a *price* for future trade and the *quality* of the good to be traded. If breach occurs, where either the seller (the buyer) fails to deliver (accept) the good, or the seller delivers a good of inadequate quality, the breached-against party can ask for *expectation damages* at trial. Under this commonly-applied legal

[1] In their seminal paper, Che and Hausch (1999) also allow for hybrid investments and prove for a special informational setting that, if investments are sufficiently cooperative, contracting becomes irrelevant. In contrast, Che and Chung (1999), who deal with legal breach remedies, consider a different informational set-up and only allow for *purely* cooperative investments. Cooperative investments were first studied in an incomplete contract setting by MacLeod and Malcomson (1993) and are also referred to as "cross investments" (e.g. Guriev, 2003) or "investments with externalities" (e.g. Nöldeke and Schmidt, 1995). Other articles that consider cooperative investments include e.g. Bernheim and Whinston (1998), Maskin and Moore (1999), De Fraja (1999), Rosenkranz and Schmitz (1999), Segal and Whinston (2002), and Roider (2004).

remedy, the victim of breach receives a payment that makes him as well off as performance would have. We show that, under this legal regime, the contract induces first-best investment incentives and the efficient ex-post breach decision when the parties set the quality required under the contract sufficiently high.[2] This result holds independent of whether parties can renegotiate. However, if the quality specification is set at an intermediate level, investment incentives are inefficient and the standard result (see e.g. Posner, 1977; Shavell, 1980; Kornhauser, 1986; Craswell, 1988) that expectation damages induce the ex-post efficient breach decision can be shown to no longer hold. The result generalizes Stremitzer (2008b) who has analyzed the same legal regime in a setting of purely cooperative investments.[3]

What makes this result interesting is that another well known efficiency result for this setting, due to Che and Chung (1999), cannot be generalized to the hybrid case. Che and Chung (1999) assume that parties can write a contract in which they stipulate the *price* of the good to be traded and an *up-front payment*. If breach occurs, under which the buyer refuses to accept the good, the seller can ask for *reliance damages*, i.e., he is reimbursed his non-recoverable investment expenses. Che and Chung (1999) show that there exists a price for which the contract induces the first best if renegotiation is possible. Yet, the logic of the argument cannot be extended to the hybrid setting. Indeed, it is always possible to construct

[2] Edlin (1996) also analyses 'Cadillac contracts' in the context of expectation damages but makes a different point: He considers a setting where the seller makes *selfish* investments. In the absence of a contract, there will be underinvestment due to the hold-up problem. If, however, the contract stipulates the highest possible quality/quantity, and it is the buyer who breaches the contract, the seller will overinvest. This is because he is fully insured and fails to take into account the states of the world where it is inefficient to trade (This is a version of the 'overreliance' result by Shavell (1984) who implictly assumes Cadillac contracts by modelling the trade decision as binary). To solve this problem, Edlin (1996) proposes to set the price so low, that it will always be the investing seller who breaches the contract. That makes him the residual claimant and provides him with efficient investment incentives. Yet, in order to make the seller accept a contract with such a low price, the buyer has to pay the seller a lump sum up front. By contrast, in our model, we are concerned with *hybrid* investments and need not rely on any up-front payments.

[3] Che and Chung (1999) had argued that 'expectation damages' perform very badly in such a setting inducing *zero* cooperative investments. Yet, as Stremitzer (2008b) has shown this follows from their implicit assumption that the contract stays silent in terms of *required quality* which will rarely be the case. Indeed, even if the parties do not stipulate anything explicit as to quality in their contract (express warranty), the court will do it for them by default, e.g. by requiring the good to serve its ordinary purpose (implied warranty of merchantability, see Section 2-314 and 2-315 of the Uniform Commercial Code (UCC)). Taking this feature of real world contracting into account, Stremitzer (2008b) shows that 'expectation damages' will always induce *positive* levels of cooperative investments and achieve the first best if parties choose a sufficiently high quality specification.

examples where reliance damages induce overinvestment regardless of price. Although the precise argument is more complicated, this negative result is driven by the well known insight that reliance damages induce overinvestment if investments are purely selfish (Shavell, 1980; Rogerson, 1984). For this reason, it is not surprising that overinvestment occurs when investment is sufficiently selfish.[4]

Our paper is organized as follows: Section 2 describes our model and Section 3 derives the socially optimal level of investment. We then show in Section 4, that the argument by Che and Chung (1999) on the efficiency of reliance damages cannot be extended to the hybrid case. Section 5 contains our main result that first-best investment levels can be achieved under expectation damages if the quality required under the contract is set sufficiently high. If not, investment incentives will be inefficient and expectation damages may even fail to induce the efficient ex-post trade decision. Section 6 concludes.

2 The model

Consider a buyer-seller relationship where risk-neutral parties potentially trade a good. At date 0, the parties sign a contract (see Figure 1). The contract specifies a fixed price, p, which has to be paid by the buyer if the seller performs in accordance with the contract and, in the case of expectation damages, a quality threshold, $\bar{v}$. Furthermore assume that the parties can specify a lump sum transfer, t, from the seller to the buyer. At date 1, the seller makes a relation-specific investment, $e \in \mathbb{R}_0^+$, which stochastically determines the buyer's benefit from trade as well as the seller's cost of production. At date 2, both the buyer's benefit from trade, v, and the seller's potential cost of performance, c, are drawn from the intervals $[0, v_h]$ and $[c_l, c_h]$ by the conditional distribution functions $F(\cdot|e)$ and $G(\cdot|e)$ respectively.[5] At date 3, the parties play a breach game in which it is decided whether trade occurs or not. When renegotiations are possible, they are costless and can occur anytime between date 3 and date 4 when parties have to make the final trade decision. The potential renegotiation surplus is

[4] That is, if the effect of seller's investment on the cost of production is sufficiently large relative to the effect on the good's quality.

[5] Note that both cost c and value v only materialize in the event of trade.

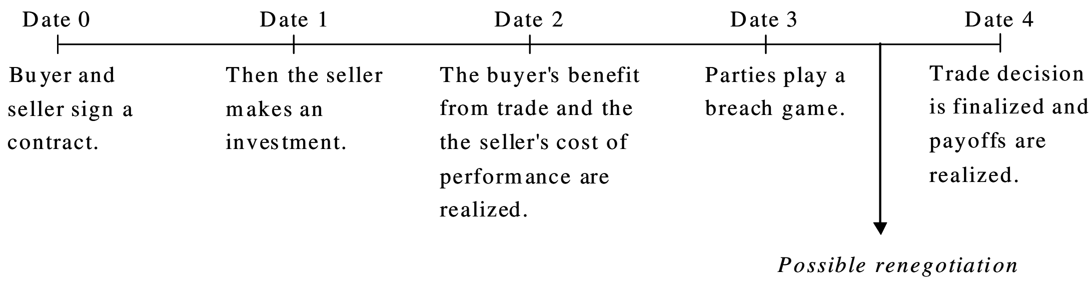

Figure 1: Timeline.

split at an exogenously given ratio with the seller receiving a share of $\alpha \in [0, 1]$.

As an example, consider the case where an engineering firm develops a new motor for a car manufacturer. In the first stage, the engineering firm invests in know-how and develops a construction plan. The know-how may reduce the costs of production and/or increase the quality of the motor. Once the construction plan is ready, the parties know the costs and benefits associated with the motor. Only then do they decide whether the motor shall be produced.

The informational setting of the model depends on the breach remedy under investigation. Under reliance damages, the court must be able to verify the seller's investment whereas, under expectation damages, it must be able to verify the buyer's valuation and the seller's variable costs. Note that this information is also sufficient to decide whether the quality of the product is below or above a certain quality threshold. While investment may be private information, everything else is observable and verifiable to all parties. Finally, the following technical assumptions apply throughout:

- **Assumption 1** $F(\cdot|\cdot)$ and $G(\cdot|\cdot)$ are twice continuously differentiable.
- **Assumption 2** $F_e(\cdot|e) < 0$ and $F_{ee}(\cdot|e) > 0$ for all $v \in (0, v_h)$ and $e \geq 0$.
- **Assumption 3** $G_e(\cdot|e) > 0$ and $G_{ee}(\cdot|e) < 0$ for all $c \in (c_l, c_h)$ and $e \geq 0$.
- **Assumption 4** $F_e(v|0) = -\infty$ and/or $G_e(c|0) = \infty$

  for all $v \in (0, v_h)$ and for all $c \in (c_l, c_h)$.

- **Assumption 5** $F_e(v|\infty) = 0$ for all $v \in (0, v_h)$ and $G_e(c|\infty) = 0$ for all $c \in (c_l, c_h)$

- **Assumption 6** $F_{v|c}((v|c)|e) = F_v(v|e)$ and $G_{c|v}((c|v)|e) = G_c(c|e)$ for $(c, v) \in \mathbb{R}^2$.

Assumption 2 implies that an increase in e moves the distribution to the right at a decreasing rate in the sense that $F(\cdot|e')$ first-order stochastically dominates $F(\cdot|e)$ for any $e' > e$. In the same way Assumption 3 implies that an increase in e moves the distribution to the left at a decreasing rate in the sense that $G(\cdot|e')$ first-order stochastically dominates $G(\cdot|e)$ for any $e' < e$. Assumptions 4 and 5 ensure an interior solution while Assumption 6 implies that variable costs, c, and the buyer's valuation, v, are stochastically independent. To save notation we assume that the highest possible benefit of the buyer is equal to the highest possible realization of variable cost, $v_h = c_h$.[6]

3 Benchmark

We consider the socially optimal allocation as a benchmark. A social planner cares for two things: First, he wants parties to trade whenever trade is efficient ex-post, $v \geq c$. Second, given the ex-post optimal trade decision, he wants the seller to choose the investment level e^* which maximizes the expected gains of trade:

$$e^* \in arg\ max\ W(e) = \int_{c_l}^{c_h} \int_{c}^{v_h} (v - c) F_v(v|e)\ dv\ G_c(c|e)\ dc - e. \tag{1}$$

Twice integrating by parts and differentiating, the efficient investment level, e^*, can be characterized by the following first-order condition:

$$W'(e^*) = \int_{c_l}^{c_h} ([1 - F(c|e^*)]\ G_e(c|e^*) - F_e(c|e^*)\ G(c|e^*))\ dc - 1 = 0. \tag{2}$$

We assume that W(e) is strictly quasi-concave in e. This ensures that e^* is unique and well defined.

[6] Our main results remain qualitatively the same if this assumption is relaxed.

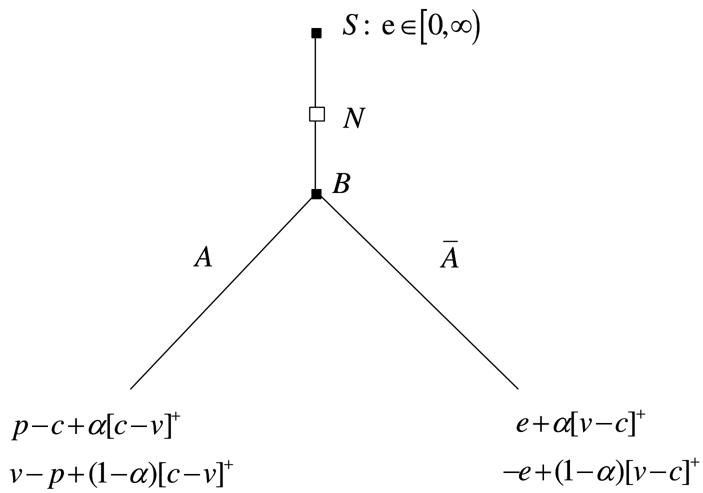

Figure 2: Subgame induced by reliance damages if renegotiations are possible.

4 Reliance damages with renegotiations

Che and Chung (1999) show that, in a setting of purely cooperative investments, there exists a price such that reliance damages induce the first best if renegotiation is possible. On the other hand, Shavell (1980) and Rogerson (1984) show that reliance damages perform poorly in an environment of selfish investments, inducing overreliance. These two results lead us to the question of how reliance damages perform in a hybrid setting, which contains aspects of both cooperative and selfish investments. We find that it is not possible to extend the result by Che and Chung (1999) to the hybrid case. Indeed, reliance damages may fail to induce the first best regardless of price.[7] To show this, we analyze the game induced by a simple contract specifying price, p, and potentially some lump sum transfer, t, if that contract is governed by reliance damages (see Figure 2). Under reliance damages, the seller is reimbursed his reliance expenses e if the buyer announces breach ($\bar{A}$). If the buyer is willing to accept the good and trade occurs the seller and the buyer receive $p - c$ and $v - p$, respectively.[8] Moreover, whenever the buyer's decision is ex post inefficient, the parties

[7] Since Che and Chung (1999) have already shown that 'reliance damages' fail to induce the first best in a setting of purely cooperative investments if renegotiation is not possible, we focus on the case where renegotiation is possible.

[8] In order to stay close to the setting studied by Che and Chung (1999), we stick to their assumption that only the buyer can breach the contract.

renegotiate towards the ex post efficient trade decision and split the potential renegotiation surplus with the seller receiving a fixed share of $\alpha \in [0, 1]$.[9] For example, if $v > c$, but the buyer announces breach, the seller derives $\alpha[v - c]^+$ from renegotiations, where we shall frequently use the notation $[\cdot]^+ = max[\cdot, 0]$. Hence, the buyer will announce breach if and only if

$$-e + (1 - \alpha)[v - c]^+ > v - p + (1 - \alpha)[c - v]^+ \tag{3}$$

or equivalently if

$$v < \hat{v} \equiv min\ [\frac{p - e - c}{\alpha} + c,\ v_h]. \tag{4}$$

So far the analysis is identical to Che and Chung (1999) except that cost of production is deterministic in their setting while it is stochastic in ours. Let us now revisit the intuition behind Che and Chung's result that there always exists a price which induces first-best investment in a setting of purely cooperative investments. First, note that the seller's expected payoff decreases in e, conditional on the buyer accepting the good. Since the buyer will never breach if price is set sufficiently low the parties can implement zero investment by specifying $p = 0$. A very high price, on the other hand, ensures that the buyer always announces breach. Given the reliance damages remedy, the seller is sure to regain his investment and, in addition, to receive a renegotiation surplus of $\alpha[v - c]^+$, which is increasing in e. Anticipating this, the seller invests as much as he can, overinvesting relative to the efficient level.[10] Hence, given the continuity of the seller's expected payoff function there must exist an intermediate price that induces first-best investment.

However, this simple intuition fails in a setting of hybrid investments. To see this, first consider the case where the parties specify a very high price. Again, the seller overinvests because his payoff $\alpha[v - c]^+ + e - e$ is strictly increasing in e. Yet, if $p = 0$, it does not necessarily remain true that the seller chooses zero investments, as his expected cost of

[9] Note that the bargaining set-up considered in Che and Hausch (1999) and Che and Hausch (1999) differs from Rogerson (1984) who implicitly assumes that parties can only renegotiate prior to the buyer's breach decision. Also Lyon and Rasmusen (2004) and Watson (2007) consider alternative bargaining models.

[10] Technically speaking, the seller's investment would be arbitrarily close to infinity since Che and Chung (1999) do not impose any wealth constraint but assume $e \in R_0^+$.

production decreases in e. We can prove the following proposition:

Proposition 1 *If parties can stipulates a price, p, and a lump sum payment, t, and their contract is governed by reliance damages, a price inducing first-best hybrid investments does not always exist.*

Proof. To prove Proposition 1, it is sufficient to construct an example where the seller overinvests regardless of price. Here, we consider the simple case where the seller's bargaining power is very small, $\alpha \longrightarrow 0$.[11] The proof comes in three steps. (i) We derive the investment level that maximizes the seller's expected payoff. (ii) Let $e^{\overline{RD}}$ be the investment level that maximizes the seller's expected payoff for $p = 0$. We can then derive a condition for which $e^{\overline{RD}}$ is higher than the social optimal level, e^*. (iii) We show that the seller never invests less than $e^{\overline{RD}}$ if the contract specifies a positive price. If the condition that is given in the second part of the proof holds, it then directly follows that the seller overinvests regardless of price.

(i) Anticipating the buyer's decision at date 3, the seller, at date 1, expects to receive the following payoff at date 1:

$$U^{RD}(e) = \int_{c_l}^{c_h} \int_0^{\hat{v}} (e + \alpha[v - c]^+) F_v(v|e) \; dv \; G_c(c|e) \; dc \tag{5}$$
$$+ \int_{c_l}^{c_h} \int_{\hat{v}}^{v_h} (p - c + \alpha[c - v]^+) F_v(v|e) \; dv \; G_c(c|e) \; dc - e.$$

We assume that $U^{RD}(e)$ is strictly quasi-concave in e for all p to ensure that there exists a unique equilibrium investment level. Let $\tilde{v} \equiv \frac{p-e-c_h}{\alpha} + c_h$ and $\hat{c} \equiv \frac{p-e-\alpha v_h}{1-\alpha}$ where $\hat{c}$ is defined such that $c \leq \hat{c}$ implies $\hat{v} = v_h$ and $c \geq \hat{c}$ implies $\hat{v} = \frac{p-e-c}{\alpha} + c$ (see expression 4). Twice

[11] It is not necessary that the seller's bargaining power is marginal, as in our example, to prove that overreliance can occur. However this example allows for a relatively simple intuition compared to cases of larger bargaining powers.

integrating by parts and reorganizing we can rewrite (5) as follows:[12]

$$
\begin{aligned}
U^{RD}(e) = p - e - c_h - \alpha \int_{c_h}^{\tilde{v}} F(v|e) + \int_{c_l}^{c_h} G(c|e)\ dc \qquad (6) \\
- \alpha \int_{c_l}^{c_h} F(c|e)G(c|e)\ dc - (1-\alpha) \int_{\hat{c}}^{c_h} F(\hat{v}|e)G(c|e)\ dc \\
- (1-\alpha) \int_{c_l}^{\hat{c}} G(c|e)\ dc.
\end{aligned}
$$

Hence, the investment level e^{RD} that maximizes the seller's expected payoff is given by the following first-order condition:

$$
\begin{aligned}
U_e'^{RD}(e^{RD}) = F(\tilde{v}|e^{RD}) - \alpha \int_{c_h}^{\tilde{v}} F_e(v|e^{RD})\ dv + \int_{c_l}^{c_h} G_e(c|e^{RD})\ dc \qquad (7) \\
- \alpha \int_{c_l}^{c_h} [F_e(c|e^{RD})G(c|e^{RD}) + F(c|e^{RD})G_e(c|e^{RD})]\ dc \\
- (1-\alpha) \int_{\hat{c}}^{c_h} [F_e(\hat{v}|e^{RD}) - \frac{1}{\alpha} F_v(\hat{v}|e^{RD})]\ G(c|e^{RD})\ dc \\
- (1-\alpha) \int_{\hat{c}}^{c_h} F(\hat{v}|e^{RD})G_e(c|e^{RD})\ dc + [1 - F(\hat{v}|e^{RD})]G(\hat{c}|e^{RD}) \\
- (1-\alpha) \int_{c_l}^{\hat{c}} G_e(c|e^{RD})\ dc - 1 = 0.
\end{aligned}
$$

(ii) To show that overinvestment relative to the socially optimal level can arise for $p = 0$, consider the case where the seller's bargaining power is very small, $\alpha \longrightarrow 0$. Inserting p = 0 into (7) yields:

$$
\begin{aligned}
U_e'^{RD}(e^{\overline{RD}}) = \alpha \int_{\tilde{v}}^{c_h} F_e(v|e^{\overline{RD}})\ dv + \int_{c_l}^{c_h} G_e(c|e^{\overline{RD}})\ dc \qquad (8) \\
- \alpha \int_{c_l}^{c_h} [F_e(c|e^{RD})G(c|e^{\overline{RD}}) + F(c|e^{\overline{RD}})G_e(c|e^{\overline{RD}})]\ dc - 1 = 0
\end{aligned}
$$

and the limit as α goes to zero is given by:

$$
\lim_{\alpha \to 0} U'^{RD}(e^{\overline{RD}}) = \int_{c_l}^{c_h} G_e(c|e^{\overline{RD}})\ dc - 1 = 0.
$$

It is clear that $e^{\overline{RD}} > e^*$ if the first derivative of the expected social welfare function (2)

[12] See Appendix 7.1 for omitted intermediate steps.

evaluated at $e^{\overline{RD}}$ is negative:[13]

$$W'(e^{\overline{RD}}) = \int_{c_l}^{c_h} ([1 - F(c|e^{\overline{RD}})]G_e(c|e^{\overline{RD}}) - F_e(c|e^{\overline{RD}})G(c|e^{\overline{RD}}))\ dc - 1 < 0 \qquad (9)$$
$$\iff + \int_{c_l}^{c_h} [-F(c|e^{\overline{RD}})G_e(c|e^{\overline{RD}}) - F_e(c|e^{\overline{RD}})G(c|e^{\overline{RD}})]\ dc < 0.$$

This is indeed the case for those parameter constellations where the first negative term in the second line of (9) is larger in absolute value than the second, positive, term or where the selfish effect of investment is strong relative to the cooperative effect, $G_e(c|e^{\overline{RD}}) >> -F_e(c|e^{\overline{RD}})$.

(iii) In appendix 7.2 we show that the seller invests at least $e^{\overline{RD}}$ if a positive price has been specified in the contract. ■

Even though the proof of Proposition 1 is rather tedious, the intuition behind it is straightforward. We can see from Figure 2 that if parties set the price very low, say at $p = 0$, the buyer always accepts delivery and the seller's payoff is $p - c$ for $v \geq c$ and $p - (1 - \alpha)\, c - \alpha v$ for $v < c$. Hence, his payoff always increases as cost becomes lower, while a benevolent social planner disregards the cost-decreasing effect of investment for $v < c$. It may thus occur that the seller overinvests at price $p = 0$. This is especially likely if the seller's bargaining power α is low and investment mainly affects cost and only has marginal influence on quality v. Given this possibility, it suffices to show that a positive price will never induce the seller to invest less. This is true, as increasing the price only makes it more likely that the buyer announces breach.[14] Yet, the seller's payoff in case of breach $\alpha[v - c]^+ + e - e$ is increasing in e. If the buyer always breached investment incentives would even be indefinitely high. Therefore, investment incentives rise in p.

Hence, the efficiency result derived by Che and Chung (1999) for reliance damages in a setting of purely cooperative investments does not generalize to the hybrid case. However, we will show in the next section that such a generalization is possible for the efficiency result derived for the expectation damages remedy in Stremitzer (2008b).

[13]Strict quasi-concavity of W(e) in e ensures that W(e) is single peaked and therefore $W'(e^{\overline{RD}}) < 0$ implies $e^{\overline{RD}} > e^*$.

[14]If the price is smaller than $(1 - \alpha)c_l$, the buyer still always accepts delivery. Then the seller invests the same amount as if a $p = 0$ had been specified in contract.

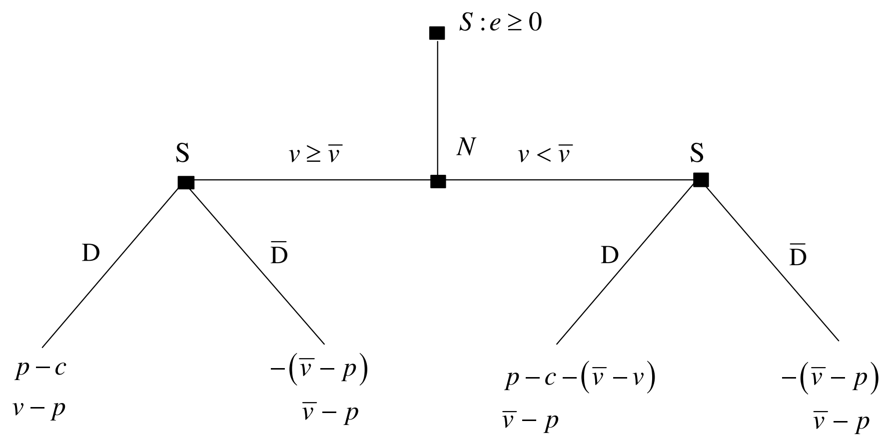

Figure 3: Subgame induced by expectation damages.

5 Expectation damages

5.1 Expectation damages without renegotiations

In contrast to the case of reliance damages, where it is impossible to achieve ex-post efficiency if renegotiation is ruled out, a standard result of the law and economics literature suggests that the expectation damages remedy induces the ex-post efficient trade decision (see e.g. Posner, 1977; Shavell, 1980; Kornhauser; Craswell, 1988). Hence, it may be possible to derive an efficiency result even without renegotiation.

Assuming the buyer never refuses delivery,[15] the seller faces the following decision: If he decides to deliver the good, he receives the trade price but has to incur the costs of production and therefore receives a trade surplus of $p - c$ (see Figure 3). Under expectation damages, the victim of breach receives a payment that makes him as well off as performance would have. It thus follows that if the good is of inferior quality, $v < \bar{v}$, the seller has to pay damages amounting to $\bar{v} - v$. If the seller refuses to deliver, and assuming $\bar{v} \geq p$,[16] the buyer receives his contractually assured trade surplus of $\bar{v} - p$ regardless of the good's quality.

We will now solve the game by backwards induction. If $v < \bar{v}$, the seller will deliver if

[15] We show in Appendix 7.3 that this simplifying assumption does not change the analysis of this and the following subsection.

[16] As a matter of real world contracting, $p < \bar{v}$ seems to be a natural assumption, as courts tend to set $\bar{v}$ higher as the price increases. Note that $\bar{v} < p$ would imply that the seller does not have to pay any damages if he decides not to deliver.

and only if it is ex-post efficient to do so ($p - c - (\bar{v} - v) \geq -(\bar{v} - p) \iff v \geq c$). However, if the buyer's valuation turns out to be above the threshold, $v \geq \bar{v}$, the seller will deliver if and only if $p - c \geq -(\bar{v} - p)$, or equivalently $c \leq \bar{v}$. Hence, for $\bar{v} < c < v$, the seller's trade decision is ex-post inefficient. We can therefore write the following proposition:

Proposition 2 *If parties specify a threshold below the highest possible realization of quality, $\bar{v} < v_h$, expectation damages fail to generally induce ex-post efficient trade.*

The result is surprising as expectation damages are commonly seen to induce the ex-post efficient breach decision. Given the seller's decision at date 3, he expects the following payoff at date 1:

$$
\begin{aligned}
U^{ED}(e) = & \int_{c_l}^{\bar{v}} \int_{\bar{v}}^{v_h} (p - c) \; F_v(v|e) \; dv \; G_c(c|e) \; dc \\
& + \int_{c_l}^{\bar{v}} \int_{c}^{\bar{v}} [(p - c) - (\bar{v} - v)] \; F_v(v|e) \; dv \; G_c(c|e) \; dc \\
& + \int_{c_l}^{\bar{v}} \int_{0}^{c} -(\bar{v} - p) \; F_v(v|e) \; dv \; G_c(c|e) \; dc \\
& + \int_{\bar{v}}^{c_h} \int_{0}^{v_h} -(\bar{v} - p) \; F_v(v|e) \; dv \; G_c(c|e) \; dc - e.
\end{aligned} \tag{10}
$$

Integrating by parts and reorganizing allows us to simplify (10):

$$
U^{ED}(e) = p - \bar{v} - e + \int_{c_l}^{\bar{v}} [1 - F(c|e)] G(c|e) \; dc. \tag{11}
$$

The seller's optimal investment level, e^{ED}, can then be characterized by the following first-order condition:

$$
U'^{ED}(e^{ED}) = \int_{c_l}^{\bar{v}} ([1 - F(c|e^{ED})] \; G_e(c|e^{ED}) - F_e(c|e^{ED}) \; G(c|e^{ED})) \; dc - 1 = 0. \tag{12}
$$

We can derive the following proposition:

Proposition 3 *If renegotiation is impossible and parties specify a sufficiently high quality threshold, $\bar{v} \geq v_h = c_h$, expectation damages induce the first best.*

Proof. If $\bar{v} \geq v_h = c_h$, we know from Proposition 2 that the seller's breach decision is ex-post efficient. Comparing expression (12) with the benchmark condition (2) we also see that $\bar{v} \geq v_h = c_h$ ensures that the seller chooses the socially optimal investment level. ■

Note that the parties do not need lump sum transfers to divide the ex ante expected gains from trade but can use the price as an instrument to do so. The intuition behind Proposition 3 is that the seller is made a residual claimant. If $\bar{v} \geq c_h$, he receives the entire trade surplus minus a constant term, $(\bar{v} - p)$. Therefore his investment incentives must coincide with the social optimum. The first best can be achieved since a high threshold also ensures that the delivery decision is efficient. Note that our first-best result holds even if the seller's expected payoff function, $U^{ED}(e)$, is not strictly quasi-concave in e for all $\bar{v}$. To derive results outside the first best, we have to impose stronger assumptions on the seller's expected payoff function. We prove the following lemma:

Lemma 1 *(i) If the contract specifies a low quality level, $\bar{v} < c_h$, and U^{ED} is strictly quasi-concave in e for all $\bar{v}$, the seller underinvests. (ii) If U^{ED} is strictly concave in e for all $\bar{v}$, investment incentives rise in the level of required quality.*

Proof. (i) To see that underinvestment will be the norm recall that $U'^{ED}(e^*) = 0$ if $\bar{v} = c_h$. Fixing $e = e^*$, we consider $U'^{ED}(\cdot)$ as a function of $\bar{v}$. The seller has lower investment incentives relative to the socially optimal level if $U'^{ED}(\bar{v}) < 0$ for all $\bar{v} < c_h$.[17] This is true because, for all $\bar{v} < c_h$

$$
\begin{aligned}
U'^{ED}(\bar{v}) &= \int_{c_l}^{\bar{v}} ([1 - F(c|e^*)]\ G_e(c|e^*) - F_e(c|e^*)\ G(c|e^*))\ dc - 1 \\
&= \int_{c_l}^{c_h} ([1 - F(c|e^*)]\ G_e(c|e^*) - F_e(c|e^*)\ G(c|e^*))\ dc - 1 \\
&\quad - \int_{\bar{v}}^{c_h} ([1 - F(c|e^*)]\ G_e(c|e^*) - F_e(c|e^*)\ G(c|e^*))\ dc < 0.
\end{aligned} \tag{13}
$$

Note that the term in the second line of (13) is equal to zero whereas the term in the third line must be negative by assumptions 2 and 3.

[17]Strict quasi-concavity of U^{ED} in e for all $\bar{v}$ ensures that U^{ED} is single peaked and hence the following argument is valid. Note that strict quasi-concavity is a common assumption to ensure a unique equilibrium level.

(ii) If $U^{ED}(e)$ is strictly concave in e for all $\bar{v}$, investment incentives rise in the level of required quality. To see this note that investment incentives rise in the threshold if $\frac{de^{ED}}{d\bar{v}} > 0$. Implicitly differentiating 12 and rearranging, we have:

$$\frac{de^{ED}}{d\bar{v}} = -\frac{\{[1 - F(\bar{v}|e^{ED})]G_e(\bar{v}|e^{ED}) - F_e(\bar{v}|e^{ED})G(\bar{v}|e^{ED})\}\ dc}{\int_{c_l}^{\bar{v}}\{[1 - F(c|e)]G_{ee}(c|e) - F_{ee}(c|e)G(c|e) - 2F_e(c|e)G_e(c|e)\}\ dc}. \tag{14}$$

The numerator of (14) must be positive due to assumptions 2 and 3. Strict concavity implies that the denominator of (14) must be negative because it is equivalent to U''^{ED}. Hence we can conclude that $\frac{de^{ED}}{d\bar{v}} > 0$. ■

Intuitively, underinvestment occurs for two reasons: If the product is conforming to the contract, $v \geq \bar{v}$, and the seller decides to deliver he receives $p - c$. If $v > c > \bar{v}$ the seller refuses to deliver and pays damages of $-(\bar{v} - p)$ even though it would be socially optimal to trade. In both cases, he does not take into account the value-increasing effect of his investment. Since both sources of inefficiency diminish as $\bar{v}$ approaches v_h, investment incentives increase in the threshold value $\bar{v}$. The result extends the proof of Stremitzer (2008b) that it is possible to implement the efficient outcome with expectation damages in a setting of purely cooperative investment to the hybrid case. As will be seen in the next section, a similar result can be derived for the case where renegotiation is possible.

5.2 Expectation damages with renegotiations

If renegotiation is possible, the parties use the payoff they would receive in the absence of renegotiation as a threat point. Consequently the payoffs in Figure 3 must be adjusted such that the potential effect of renegotiation is taken into account (see Figure 4).[18]

Recall from Proposition 2 that an optimal contract governed by expectation damages, $\bar{v} \geq v_h = c_h$, induces an efficient ex-post delivery decision. Proposition 4 directly follows:

Proposition 4 *If renegotiations are possible and parties specify a sufficiently high quality threshold, $\bar{v} \geq v_h = c_h$, expectation damages induce the first best.*

[18] Note that we assume that $p \leq \bar{v}$ which allows us to simplify payoffs.

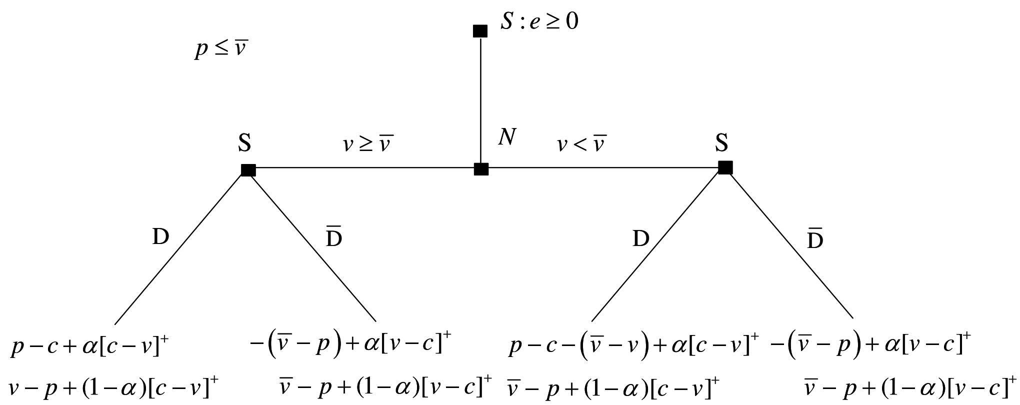

Figure 4: Subgame induced by expectation damages if renegotiation is possible.

The intuition behind Proposition 4 is that an efficient ex-post delivery decision renders renegotiations worthless. Hence, payoffs in equilibrium are the same as in the no-renegotiation case and the investment incentives coincide.

6 Conclusion

It is reassuring that expectation damages, the default remedy of common law, not only performs well in a setting of purely cooperative investments but also in the hybrid case. Indeed, the *same* Cadillac contract which achieves the first best in the purely cooperative setting also achieves the first best in the hybrid case. Under reliance damages, on the other hand, parties must fine-tune the contract price, stipulate up-front payments, and rely on renegotiation to achieve the first best. Even then, they cannot achieve the first best when investments are sufficiently selfish. Our analysis therefore suggests that parties should think twice before opting out of default expectation damages for privately stipulated reliance damages, in contrast to the recommendation of Che and Chung (1999). Indeed, reliance damages could only be attractive when informational constraints render reliance damages easier to assess than expectation damages. A more troubling result regarding expectation damages is that efficient breach is only guaranteed if parties set the quality threshold sufficiently high. Otherwise parties must rely on renegotiation to achieve the ex-post efficient allocation.

Finally, our analysis illustrates a subtle difference between mechanism design and the economic analysis of real world institutions. As we have already mentioned, the enforcement of reliance damages requires investment to be verifiable. Then, however, parties should theoretically be able to achieve the first best by writing a forcing contract in which they stipulate the efficient investment level. Yet, we show that this does not necessarily imply that reliance damages induce the first best. Indeed, the issue is *not* whether the information required to operate an institution is in theory sufficient to achieve the first best. It is about how institutions make use of that information.[19]

[19] Both Che and Chung (1999) and Schweizer (2006) prove interesting results, although, by requiring investment to be verifiable, their insights are not surprising from the perspective of contract theory.

7 Appendix

7.1 Proof of Proposition 1, Part (i)

If the buyer announces acceptance of the good, the parties receive their respective trade surpluses, $p - c$ and $v - p$, and share the potential renegotiation surplus with the seller receiving $\alpha[c - v]^+$. If the buyer announces refusal of the good, the seller's investment serves as a threat point during renegotiation. The parties share a potential renegotiation surplus with the seller receiving $\alpha[v - c]^+$. Hence the buyer announces breach if

$$-e + (1-\alpha)[v-c]^+ > v - p + (1-\alpha)[c-v]^+ \tag{15}$$

or equivalently

$$v < \hat{v} \equiv min\ [\frac{p-e-c}{\alpha} + c,\ v_h]. \tag{16}$$

Anticipating this, the seller expects to receive the following payoff at date 1:

$$\begin{aligned} U^{RD}(e) = & \int_{c_l}^{c_h} \int_0^{\hat{v}} (e + \alpha[v-c]^+) F_v(v|e) dv\ G_c(c|e)\ dc \\ & + \int_{c_l}^{c_h} \int_{\hat{v}}^{v_h} (p - c + \alpha[c-v]^+) F_v(v|e) dv\ G_c(c|e)\ dc - e \\ = & \int_{c_l}^{c_h} \{[p-e-c][1 - F(\hat{v}|e)] + \alpha \int_0^{\hat{v}} [v-c]^+ F_v(v|e)\ dv \\ & + \alpha \int_{\hat{v}}^{v_h} [c-v]^+ F_v(v|e) dv\} G_c(c|e)\ dc. \end{aligned} \tag{17}$$

The term inside {...} can be rewritten as:

$$\begin{aligned} & \alpha \int_0^{\hat{v}} [v-c]^+ F_v(v|e)\ dv + \alpha \int_0^{v_h} [c-v]^+ F_v(v|e)\ dv \\ & - \alpha \int_0^{\hat{v}} [c-v]^+ F_v(v|e)\ dv + [p-e-c][1-F(\hat{v}|e)] \\ & = \alpha \int_0^{\hat{v}} (v-c) F_v(v|e)\ dv + \alpha \int_0^{v_h} [c-v]^+ F_v(v|e)\ dv + [p-e-c][1-F(\hat{v}|e)] \\ & = \alpha \int_0^{\hat{v}} \alpha\ (v-c) F_v(v|e)\ dv - \alpha \int_0^{c} (v-c) F_v(v|e)\ dv + [p-e-c][1-F(\hat{v}|e)] \\ & = \alpha \int_c^{\hat{v}} (v-c) F_v(v|e)\ dv + [p-e-c][1-F(\hat{v}|e)]. \end{aligned} \tag{18}$$

Integration by parts yields,

$$\alpha(\hat{v}-c)F(\hat{v}|e)-\alpha\int_c^{\hat{v}}F(v|e)\,dv+[p-e-c][1-F(\hat{v}|e)]. \tag{19}$$

Using (19) we can rewrite (17) as

$$U^{RD}(e)=\int_{c_l}^{c_h}\{[p-e-c][1-F(\hat{v}|e)]+\alpha(\hat{v}-c)F(\hat{v}|e)-\alpha\int_c^{\hat{v}}F(v|e)\,dv\}G_c(c|e)\,dc \tag{20}$$

$$=\int_{c_l}^{c_h}\{p-e-c+F(\hat{v}|e)\;\alpha[\hat{v}-(\frac{p-e-c}{\alpha}+c)]-\alpha\int_c^{\hat{v}}F(v|e)\,dv\}G_c(c|e)\,dc.$$

Applying integration by parts again yields,

$$\begin{aligned}U^{RD}(e)&=[\{p-e-c-\alpha\int_c^{\hat{v}}F(v|e)\,dv\}G(c|e)]_{c_l}^{c_h}+\int_{c_l}^{c_h}G(c|e)\,dc \\ &-\alpha\int_{c_l}^{c_h}F(c|e)G(c|e)\,dc+\alpha\int_{c_l}^{c_h}\frac{d\hat{v}}{dc}\,F(\hat{v}|e)G(c|e)\,dc \\ &+\int_{c_l}^{c_h}F(\hat{v}|e)\;\alpha[\hat{v}-(\frac{p-e-c}{\alpha}+c)]\;G_c(c|e)\,dc.\end{aligned} \tag{21}$$

As an intermediate step, we can simplify the term in the last line of (21):

$$\int_{c_l}^{c_h}F(\hat{v}|e)\;\alpha[\hat{v}-(\frac{p-e-c}{\alpha}+c)]\;G_c(c|e)\,dc. \tag{22}$$

First we define $\hat{c}\equiv\frac{p-e-\alpha v_h}{1-\alpha}$. Note that $c<\hat{c}$ implies $\hat{v}=v_h$, whereas $c>\hat{c}$ implies $\hat{v}=\frac{p-e-c}{\alpha}+c$. In the latter case (22) is equal to zero. Thus, we can rewrite (22):

$$\begin{aligned}&\int_{c_l}^{\hat{c}}[\alpha v_h-p+e+(1-\alpha)c]\;G_c(c|e)\,dc \\ &=(1-\alpha)\int_{c_l}^{\hat{c}}[\frac{\alpha v_h-p+e}{1-\alpha}+c]\;G_c(c|e)\,dc \\ &=(1-\alpha)\int_{c_l}^{\hat{c}}(c-\hat{c})\;G_c(c|e)\,dc\end{aligned} \tag{23}$$

Using (23) we can rewrite (21):

$$\begin{aligned}U^{RD}(e)&=[\{p-e-c-\alpha\int_c^{\hat{v}}F(v|e)\,dv\}G(c|e)]_{c_l}^{c_h}+\int_{c_l}^{c_h}G(c|e)\,dc \\ &-\alpha\int_{c_l}^{c_h}F(c|e)G(c|e)\,dc+\alpha\int_{c_l}^{c_h}\frac{d\hat{v}}{dc}\,F(\hat{v}|e)G(c|e)\,dc \\ &+(1-\alpha)\int_{c_l}^{\hat{c}}(c-\hat{c})\;G_c(c|e)\,dc\end{aligned} \tag{24}$$

Let $\tilde{v} \equiv \frac{p-e-c_h}{\alpha} + c_h$ and note that $\frac{d\hat{v}}{dc} = 0$ if $c < \hat{c}$. Then we can rewrite (24):

$$\begin{aligned} U^{RD}(e) &= p - e - c_h - \alpha \int_{c_h}^{\tilde{v}} F(v|e)\ dv + \int_{c_l}^{c_h} G(c|e)\ dc \\ &- \alpha \int_{c_l}^{c_h} F(c|e)G(c|e)\ dc - (1-\alpha)\int_{\hat{c}}^{c_h} F(\hat{v}|e)G(c|e)\ dc \\ &+ (1-\alpha)\{[(c-\hat{c})G(c|e)]_{c_l}^{\hat{c}} - \int_{c_l}^{\hat{c}} G(c|e)\ dc\} \\ &= p - e - c_h - \alpha \int_{c_h}^{\tilde{v}} F(v|e)\ dv + \int_{c_l}^{c_h} G(c|e)\ dc \\ &- \alpha \int_{c_l}^{c_h} F(c|e)G(c|e)\ dc - (1-\alpha)\int_{\hat{c}}^{c_h} F(\hat{v}|e)G(c|e)\ dc \\ &- (1-\alpha)\int_{c_l}^{\hat{c}} G(c|e)\ dc \end{aligned} \tag{25}$$

The seller's optimal investment level, e^{RD}, is represented by the following first-order condition:

$$\begin{aligned} U_e'^{RD}(e^{RD}) &= F(\tilde{v}|e^{RD}) - \alpha \int_{c_h}^{\tilde{v}} F_e(v|e^{RD})\ dv + \int_{c_l}^{c_h} G_e(c|e^{RD})\ dc \\ &- \alpha \int_{c_l}^{c_h} [F_e(c|e^{RD})G(c|e^{RD}) + F(c|e^{RD})G_e(c|e^{RD})]\ dc \\ &- (1-\alpha)\int_{\hat{c}}^{c_h} [F_e(\hat{v}|e^{RD}) - \frac{1}{\alpha}F_v(\hat{v}|e^{RD})]\ G(c|e^{RD})\ dc \\ &- (1-\alpha)\int_{\hat{c}}^{c_h} F(\hat{v}|e^{RD})G_e(c|e^{RD})\ dc + [1 - F(\hat{v}|e^{RD})]G(\hat{c}|e^{RD}) \\ &- (1-\alpha)\int_{c_l}^{\hat{c}} G_e(c|e^{RD})\ dc - 1 = 0. \end{aligned} \tag{26}$$

7.2 Proof of Proposition 1, Part (iii)

We have already shown in the main text that the seller overinvests relative to the socially optimal level if $p = 0$ has been specified in contract and condition (9) holds. We now show that the seller will not invest less than $e^{\overline{RD}}$, if a positive price has been specified in contract.

Consider the limit of (7) as α goes to zero:

$$\begin{aligned}\lim_{\alpha\to 0} U'^{RD}(e^{RD}) &= F(\tilde{v}|e^{RD}) + \int_{c_l}^{c_h} G_e(c|e^{RD})\ dc \\ &- \int_{\hat{c}}^{c_h} [F_e(\hat{v}|e^{RD}) - \infty F_v(\hat{v}|e^{RD})]\ G(c|e^{RD})\ dc \\ &- \int_{\hat{c}}^{c_h} F(\hat{v}|e^{RD}) G_e(c|e^{RD})\ dc + [1 - F(\hat{v}|e^{RD})]G(\hat{c}|e^{RD}) \\ &- \int_{c_l}^{\hat{c}} G_e(c|e^{RD})\ dc - 1 = 0.\end{aligned} \tag{27}$$

Fixing $e = e^{\overline{RD}}$ and considering U'^{RD} as a function of p, the seller will invest at least $e^{\overline{RD}}$ if $U'^{RD}(p) \geq 0$ for all $p > 0$.[20] After reorganizing, $U'^{RD}(p) \geq 0$ for all $p > 0$ is equivalent to the following condition:

$$\begin{aligned}\lim_{\alpha\to 0} U'^{RD}(p) &= F(\tilde{v}|e^{\overline{RD}}) + [1 - F(\hat{v}|e^{\overline{RD}})]G(\hat{c}|e^{\overline{RD}}) \\ &- \int_{\hat{c}}^{c_h} [F_e(\hat{v}|e^{\overline{RD}}) - \infty F_v(\hat{v}|e^{\overline{RD}})]\ G(c|e^{\overline{RD}})\ dc \\ &+ \int_{\hat{c}}^{c_h} [1 - F(\hat{v}|e^{\overline{RD}})]G_e(c|e^{\overline{RD}})\ dc \geq 1 \ \ \forall\ p > 0.\end{aligned} \tag{28}$$

Recall that $c \geq \hat{c}$ implies $\hat{v} = \frac{p-e-c}{\alpha} + c \leq v_h$. Then, the term in the second line makes sure that condition (28) holds unless $\hat{v} \leq 0$ or $\hat{c} \geq c_h$ for all c. In the latter two cases, the term in the second line is equal to zero. Hence, what is left is to show is that condition (28) holds if $\hat{v} \leq 0$ or $\hat{c} \geq c_h$. First, since $\hat{v} \leq 0$ must hold for all c it must in particular hold for $c = c_l$.This implies that

$$\frac{p - e^{\overline{RD}} - c_l}{\alpha} + c_l \leq 0 \Leftrightarrow c_l \geq \frac{p - e^{\overline{RD}}}{(1-\alpha)}. \tag{29}$$

Now since $p - e^{\overline{RD}} > p - e^{\overline{RD}} - \alpha v_h$, we can conclude that

$$c_l = \frac{p - e^{\overline{RD}}}{(1-\alpha)} > \frac{p - e^{\overline{RD}} - \alpha v_h}{(1-\alpha)} \equiv \hat{c}. \tag{30}$$

Then the last term of (28) is equal to 1 and because the other terms are all nonnegative, condition (28) must hold. The last step is to prove that condition (28) holds if $\hat{c} \geq c_h$. This

[20] Strict quasi-concavity of U^{RD} in e for all p ensures that $U^{RD}$is single peaked. Then $U'^{RD}(p) \geq 0$ ensures that the seller invests at least $e = e^{\overline{RD}}$ for a given p.

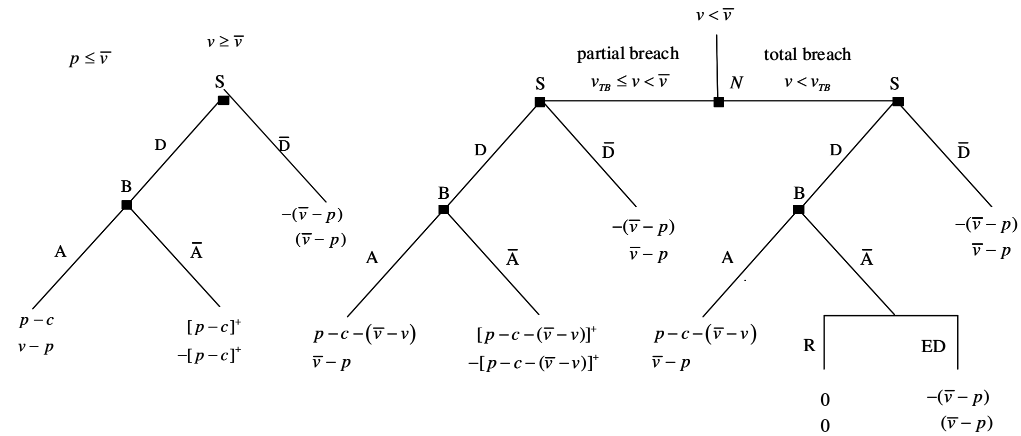

Figure 5: Expectation damages without renegotiation if the buyer can breach.

case directly implies that

$$p \geq e^{\overline{RD}} + c_h. \tag{31}$$

But if (31) holds, $F(\tilde{v}|e^{\overline{RD}}) = 1$ must be true. Then again, because all other terms are nonnegative, condition (28) must hold. Hence condition (28) holds for all $p > 0$ and we have shown that the seller will invest at least $e^{\overline{RD}}$ if $p > 0$ has been specified in the contract. Since $e^{\overline{RD}} > e^*$, the seller will overinvest relative to the socially efficient level for any price.

7.3 Allowing for Buyer's breach

7.3.1 Expectation damages without renegotiation

Rather than assuming *ad hoc* that the buyer never breaches the contract under expectation damages, we now show that legal remedies of contract law always induce the buyer to accept delivery.

Conforming quality, $v \geq \bar{v}$.

If quality is conforming, non-acceptance ($\bar{A}$) of the seller's good constitutes breach. Hence, the seller can recover damages of $[p - c]^+$ (Figure 5). The buyer will accept the good if

$$v - p \geq -[p - c]^+ \Leftrightarrow v \geq \begin{cases} p & \text{if } p \leq c \\ c & \text{otherwise} \end{cases}. \tag{32}$$

The natural assumption, $\bar{v} > p$, implies that (32) must hold. The first case, $p \leq c$, must hold because $v \geq \bar{v} > p$. The second case can only occur if $p > c$. Then, since $v \geq \bar{v} > p$ it must hold that $v > c$. Hence, the buyer will accept delivery in equilibrium.

If, on the other hand, the seller breaches by either refusing delivery or by delivering a good of non-conforming quality, we need to consider two cases. This is because, under the substantial performance doctrine of common law, different remedies will be available depending on whether the non-conformity is only partial or amounts to total breach. Let us define partial breach as a realization of v which is lower than the quality threshold $\bar{v}$ but greater than or equal to some cut-off value v_{TB}. Similarly, let total breach be defined as a realization of v which is lower than v_{TB} (non-delivery is always considered to be total breach).

Non-conformity constitutes partial breach, $v_{TB} \leq v < \bar{v}$.

If quality is non-conforming but breach due to non-conforming quality is only partial, $v_{TB} \leq v < \bar{v}$, the buyer is only allowed to demand damages for partial breach. Therefore, if the buyer rejects, the supplier can recover damages of $[p - c - (\bar{v} - v)]^+$. For $\bar{v} > p$, we see that $\bar{v} - p > 0 \geq -[p - c - (\bar{v} - v)]^+$. Hence the buyer will accept delivery.

Non-conformity constitutes total breach, $v < v_{TB}$.

If the non-conformity amounts to total breach, $v < v_{TB}$, the buyer can terminate the contract and ask for restitution (R) to recover any progress payment that he might have made to the seller. As the good has no value to the seller, both parties receive zero payoff. Alternatively, the buyer can recover damages for total breach, $[\bar{v} - p]^+$. Hence the buyer will receive $\bar{v} - p$ if he accepts the good and since we assume $\bar{v} > p$, he will also receive $\bar{v} - p$ if he rejects the good. Assuming the buyer accepts if he is indifferent, the buyer will accept delivery in equilibrium.

7.3.2 Expectation damages with renegotiation

If we assume that parties renegotiate towards the ex-post efficient trade decision, adjustments to the payoffs in Figure 5 need to be made. For example, if the buyer rejects the seller's good when trade is efficient, $v > c$, the parties renegotiate and split the resulting surplus, $v - c$,

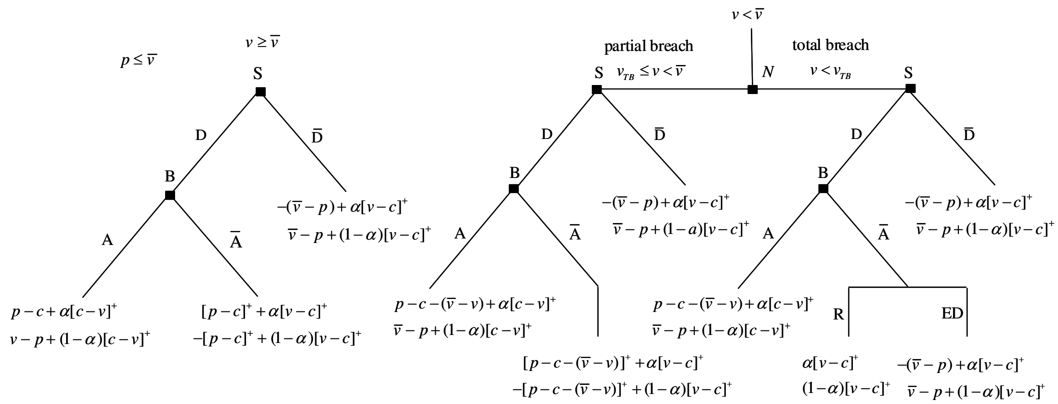

Figure 6: Expectation damages with renegotiation if the buyer can breach.

according to their respective bargaining powers. Similarly, the parties will renegotiate if the buyer accepts the good, even though $c > v$. We make one additional and crucial assumption with respect to v_{TB}, which we did not need in the case where renegotiation was ruled out: Under the substantial performance doctrine of common law, the buyer may only treat the non-conformity as total breach if $v < v_{TB} \leq \bar{v}$. In civil law countries a similar provision requires non-conformity to be "fundamental". One test to determine if non-conformity can be treated as total breach is whether or not the buyer still has an *interest* in the good despite non-conformity (in this case the non-conformity is only partial). We assume that the court will conclude that such an interest exists whenever the parties would freely renegotiate to trade: $v > c$. This implies setting $v_{TB} = c$ (see Figure 6).[21]

Conforming quality, $v \geq \bar{v} > v_{TB} = c$.

The buyer will accept the good if

$$\begin{aligned} v - p + (1-\alpha)\left[c - v\right]^+ &\geq -[p-c]^+ + (1-\alpha)\left[v-c\right]^+ \iff \\ v - p &\geq -[p-c]^+ + (1-\alpha)(v-c) \end{aligned} \tag{33}$$

or

$$v - p \geq \begin{cases} 1-\alpha)(v-c) & \text{if } p < c \\ c - p + (1-\alpha)(v-c) & \text{if } p \geq c \end{cases} . \tag{34}$$

The first case, $p < c$, holds if $v \geq \frac{p-c}{\alpha} + c$. This must be true as $v \geq \bar{v}$ implies $v > c$ and

[21]Note that we continue to assume that $p \leq \bar{v}$. This allows us to simplify payoffs.

the first case can only occur if $p < c$. The second case holds because $v - c \geq (1 - \alpha)(v - c)$. Hence the buyer will accept in equilibrium.

Non-conformity constitutes partial breach, $v_{TB} = c \leq v < \bar{v}$**.**

The buyer will accept the good if

$$\bar{v} - p + (1 - \alpha) [c - v]^+ \geq -[p - c - (\bar{v} - v)]^+ + (1 - \alpha) [v - c]^+ \iff \tag{35}$$
$$\bar{v} - p \geq -[p - c - (\bar{v} - v)]^+ + (1 - \alpha) (v - c)$$

or:

$$\bar{v} - p - (1 - \alpha) (v - c) \geq \begin{cases} 0 & \text{if } v - c \leq \bar{v} - p \\ \bar{v} - p - (v - c) & \text{if } v - c > \bar{v} - p \end{cases} .$$

In the first case, the condition must hold since $\bar{v} - p \geq v - c \geq (1 - \alpha) (v - c)$. In the second case, the condition must hold because $v - c > 0$ and $(1 - \alpha) \leq 1$. Hence the buyer will accept in equilibrium.

Non-conformity constitutes total breach, $v < v_{TB} = c$**.**

As $\bar{v} - p + (1 - \alpha) [v - c]^+ > (1 - \alpha) [v - c]^+$ the buyer chooses ED if he rejects delivery. The buyer will therefore accept if:

$$\begin{aligned} \bar{v} - p + (1 - \alpha) [c - v]^+ &> \bar{v} - p + (1 - \alpha) [v - c]^+ \iff \\ \bar{v} - p + (1 - \alpha) (c - v) &> \bar{v} - p, \end{aligned}$$

which will always hold for $v < c$.

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