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More on Damage Measures, Breach of Contract, and Renegotiation*

by

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Abstract

This paper is about contractual situations where renegotiation may occur. Due to incomplete information, the parties use damage measures as a substitute for completely specified contracts. We argue that damage measures determine the agents' outside options in the renegotiation process. Therefore, we model the strategic interaction between the two parties to the contract as a multi-stage game. We show that, contrary to a widespread belief, the possibility of renegotiation need not ensure efficient behavior under commonly used damage measures. Moreover, we derive a damage measure that induces efficient behavior.

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I. Introduction

In contractual relationships, by definition, there is a lapse of time between the writing of the contract and the promised performance. During this period the buyer often makes investments that increase the payoff she receives from the seller's promised performance. The buyer might, e.g., wish to resell the seller's good and prepare a corresponding advertising campaign. Typically, the value of these investments is to some extent specific to the relationship between the two parties to the contract. Furthermore, during this time span ex ante uncertainty is resolved. For example, the seller may receive a higher offer from someone else or face higher production costs than he expected when the contract was made. Such an event may result in the seller's failure to perform.

If the realizations of random events are the seller's private information, it is difficult for the agents to make a contract that specifies all relevant aspects of efficient contractual performance. Due to the asymmetries of information certain contingent statements are infeasible because the state of world is not observed by the buyer. Under such circumstances the parties often end up writing incomplete contracts.

To give the buyer reasonable assurances that the seller will perform and to allow the seller to cancel the agreement if necessary, the law prescribes damage measures be applied. These damage measures, or breach of contract remedies, specify the amount of damages that the defaulting seller must pay to the buyer. Obviously, the remedy available against the seller will influence his decision whether or not to perform. The remedy will also affect the buyer's investments in reliance, i.e., the expenditures she makes in anticipation of the promised performance. Damage measures may thus serve as a substitute for completely specified contracts.

Whenever the seller decided not to perform under the conditions stated in the contract, the parties may still want to renegotiate and agree on new terms of exchange. During a renegotiation the buyer has the possibility to terminate bargaining and claim damages whereas the seller can quit bargaining and pay damages. That is, the damage measure specified in the contract determines both agents' outside options in the renegotiation process. Damage measures thus not only influence the buyer's reliance choice and the seller's decision whether or not to perform under the contract. They also affect the outcome of a possible renegotiation.

The purpose of this paper is to clarify the role of damage measures in contractual situations where renegotiation may occur. To take proper account of the strategic interaction between buyer and seller, we model the reliance, the performance resp. breach decision, and the renegotiation process as a multi-stage game. We will show that, contrary to a widespread belief, the possibility of renegotiation need not ensure efficient behavior under commonly used damage measures, namely the *rule of no damages*, the *reliance measure* that puts the buyer in the position had she not signed the contract, and *expectation damages* that put the buyer in the position had the contract been performed. Our renegotiation process in itself is efficient in the sense that it does not lead to a waste of resources. Nevertheless, the seller will not initiate a renegotiation often enough because his share of the renegotiation outcome is less than what he gets elsewhere. Furthermore, we will derive a class of damage measures that induce efficient behavior.

The paper is organized as follows. In section II we describe the basic technological setup. We discuss the problems the technology creates for a successful exchange between the two parties and relate our approach to the literature. In section III we describe the game and the equilibrium concept we adopt. Section IV contains the equilibrium outcomes of our game under the above mentioned damage measures.

II. The Model

In our problem there are two risk neutral agents, a buyer and a seller. The seller will produce a good that the buyer would like to have. The buyer's valuation of the good depends on her reliance expenditure $r \geq 0$. The buyer has to invest in reliance before the good is produced and exchanged. If the buyer has engaged in a reliance level r, her monetary valuation of the good is $v(r)$. Let $v(0) = 0$ and $v'(\cdot) > 0$. If the buyer has not invested in reliance, the good is of no value to her and her valuation increases with her reliance expenditure. The buyer's net valuation of the good is $\phi(r) \equiv v(r) - r$. We assume that $\phi(\cdot)$ achieves a unique maximum at $\bar{r} > 0$ with $\phi'(\bar{r}) = 0$ and $\phi(\bar{r}) > 0$. If the buyer gets the good for sure, she picks $\bar{r}$ so as to maximize her net valuation. If the buyer does not get the good, the scrap value of her reliance investment is 0, i.e., the buyer has no possibility to get the good elsewhere.

The seller produces the good at zero cost. Before the good is produced yet after the buyer has invested in reliance, the seller receives from some outside agent an alternative bid s that is a realization of a random variable $\tilde{s}$ with support $[0, \bar{s}]$ and density $f(\cdot) > 0$. Let $\bar{s} > v(\bar{r})$. These assumptions imply the following. If the buyer gets the good for sure, she picks $\bar{r}$ so as to maximize her net valuation $\phi(\cdot)$. Yet with positive probability an alternative offer materializes that exceeds the buyers value $v(\bar{r})$.[1]

Having described the basic technological setup, we may now characterize the efficient level of reliance as well as the efficient final allocation of the good. Efficiency is measured by the sum of the buyer's and seller's expected surplus.

Proposition 1: *In an efficient allocation the buyer gets the good iff $v(r) \geq s$; otherwise, the good is allocated to the outside agent. The efficient level of reliance $r^* \in [0, \bar{r})$.*

Proof: The good is allocated after the buyer has made her reliance investment. That is, the reliance expenditure r is a bygone at the time the decision about the final allocation is made. Therefore, the allocation decision involves a comparison of the two alternative uses of the good, $v(r)$ and s. Obviously, it is efficient to allocate the good to the agent with the highest valuation.

Given this efficient allocation rule, any efficient r^* maximizes

$$\Phi(r) \equiv \int_0^{\bar{s}} max\big[v(r), s\big] f(s)ds - r = v(r) \int_0^{v(r)} f(s)ds + \int_{v(r)}^{\bar{s}} sf(s)ds - r.$$

$\Phi(\cdot)$ is differentiable. Furthermore, $\Phi(\cdot) \geq \phi(\cdot)$ and $\Phi'(\cdot) \leq \phi'(\cdot)$. Since $v(\bar{r}) < \bar{s}$, we have $\int_{v(\bar{r})}^{\bar{s}} f(s)ds > 0$. This implies $\Phi'(r) < 0 \quad \forall r \geq \bar{r}$. Consequently, $r^* \in [0, \bar{r})$.

Q.E.D.

The efficient allocation rule holds for familiar reasons. Since the reliance expenditure is sunk when the allocation decision is made, it is efficient to allocate the good to the agent with the highest valuation. The efficient level of reliance may be explained as follows. Reliance is as an investment with an uncertain payoff. Efficiency requires to stop short of $\bar{r}$ where the buyer's marginal valuation of reliance conditional on getting the good is one. Carrying reliance to $\bar{r}$ would be efficient only if the buyer got the good for sure. Yet, with positive probability the alternative bid exceeds $v(\bar{r})$.

Let us now analyze by which means the buyer and the seller can engage in successful trade. One possibility is that they agree on the terms of exchange after the buyer has invested in reliance. The buyer's payoff of the reliance investment r is positive if and only if she gets the seller's good; otherwise, it is 0. Therefore, the seller will try to appropriate the entire value $v(r)$. In terms of Klein, Crawford, and Alchian (1978) the reliance investment creates an appropriable specialized quasi rent and thus a "hold-up" problem. Anticipating the seller's strong bargaining position, the buyer will be unwilling to rely beforehand.

Another possibility is that the parties sign a contract before the buyer relies. Such a contract could, e.g., force the seller to deliver the good to the buyer. This contract assures the buyer that she will get the good and she will engage in positive reliance. Yet the contract excludes the possibility of allocating the good to the outside agent if his valuation is higher than the buyer's.

The parties could also sign a complete contingent contract saying that exchange occurs if and only if the buyer picked r^* and $v(r^*) \geq s$. Such a contract, however, is problematic if the alternative offer s is the seller's private information and thus not observable by the buyer. The seller can always claim a high outside bid should this be in his interest.

If the seller has private information, actual contracts often take the following simple form. They state that an exchange will occur at a fixed price p to be paid by the buyer to the seller upon delivery. Furthermore, they specify a rule $d(\cdot)$ for computing damages that the seller must pay to the buyer if the seller defaults on the contract. The damage rule depends on variables which are ex post verifiable by both parties to the contract as well as by the courts. Following the literature, in our analysis the damage rules depend on trade not taking place and on the buyer's reliance level r. As a shorthand we will write $d(r)$. That is, if the buyer does not get the good, she reveals her choice of r and damages are computed according to the rule $d(\cdot)$.

The purpose of the damage measure approach to contracting is to cope simultaneously with the problems of ex ante reliance and ex post allocation decisions. Its intent is to give the buyer reasonable assurances that the seller will perform so as to generate proper reliance and at the same time allow the seller to cancel the agreement if the alternative bid is high.

The damage measure approach has been studied extensively in the literature. See, e.g., Kornhauser (1983), Rogerson (1984), and Shavell (1980, 1984). Shavell (1980) considers the situation where the contract is the only possible means of exchanging the good. The seller has the option to perform or to break the contract. If he chooses breach, there is no other way that the buyer might obtain the good. In this setup Shavell analyzes the efficiency properties of various commonly used damage measures concerning the breach and reliance decision.

Rogerson (1984) allows for a second possibility of exchange.[2] If there is breach of the original contract, the buyer and the seller may renegotiate and agree on new terms of exchange. Following the Coasian tradition, Rogerson assumes that the parties renegotiate cooperatively. They first make the allocation decision so as to maximize the joint surplus $W \in \{v(r), s\}$. This implies that the buyer gets the good if and only if $v(r) \geq s$. Thus, Rogerson assumes that the allocation decision is efficient. Then the parties agree on some division of the additional pie $v(r) - s \geq 0$. In this framework Rogerson analyzes the efficiency properties of various damage measures concerning the buyer's ex ante reliance decision.

Rogerson does not explicitly take into account the strategic interaction between the seller and the buyer. The original contract determines the bargaining positions of the two parties in the renegotiation process. The seller has the possibility to terminate bargaining and pay damages whereas the buyer can claim damages. If the contract states that the buyer gets a large (small) sum of money when she is bumped, she is in a strong (weak) bargaining position and vice versa for the seller. That is, the damage measure $d(\cdot)$ specified in the contract defines both agents' outside options in the renegotiation process.

Specifically, it is unclear whether the efficient allocation decision is individually rational for the seller. Suppose $v(r) > s$ so that according to Rogerson the good is allocated to the buyer. Suppose further that the seller gets nothing of the additional pie $v(r) - s$ created by cooperative joint surplus maximizing. Following Rogerson the seller gets the payoff p, the price specified in the contract, if he renegotiates with the buyer. The seller has the outside option to give the good to the third party and pay the damages d stated in the contract. This results in a payoff $s - d$ for the seller. Since the seller decides whether to allocate the good to the outside agent or to the buyer via renegotiation, the buyer will get the good if and only if $p \geq s - d$. Accordingly, the seller's allocation decision depends on the outside bid s, as well as on the price p and the damages d that were determined in the original contract. The decision depends in no direct way on the buyer's valuation $v(r)$. Therefore, it is unclear why the seller should make the efficient decision, i.e., allocate the good to the buyer whenever $v(r) \geq s$. To circumvent this problem, Rogerson assumes that the buyer uses (unspecified) sidepayments to get the item. Yet these sidepayments are not incorporated into the formal analysis and it is unclear how they influence the buyer's reliance choice.

The purpose of this exercise is to take proper account of the strategic interaction between buyer and seller. Therefore, we model the reliance, performance resp. breach decisions, as well as the renegotiation process as a multi-stage game. We will characterize the equilibrium reliance and allocation decisions that result under three alternative damage measures, namely no damages, reliance measure, and expectation damages. We will show that the possibility of renegotiation need not automatically ensure that the seller's allocation decision is efficient. We will finally derive a class of damage measures that implement the efficient reliance level and the efficient allocation rule.

III. Game Structure and Equilibrium Concept

In stage 0 of the game the outside agent puts a letter with his bid $s \in [0, \bar{s}]$ into the mailbox. In stage 1 the buyer and the seller write a contract specifying a price p that the buyer must pay to the seller when she gets the good. Both agents are aware that the law prescribes a damage measure $d(\cdot)$ be applied. The damages $d(\cdot)$ are paid by the seller to the buyer if the buyer is left empty-handed. Both parties voluntarily sign the contract, i.e., they will not do so if their expected payoff from contracting is negative.

In stage 2 the buyer picks her reliance level r. The seller does not observe this choice.[3] In stage 3 the letter with the alternative bid arrives, i.e., the seller learns s. The buyer does not observe s. The seller then chooses between two alternatives. i) He performs under the conditions stated in the contract. This generates a payoff p for the seller and a payoff $v(r) - r - p$ for the buyer.[4] ii) He decides not to perform. In stage 4 the seller either delivers the good to the outside agent and pays damages, generating a payoff $s - d(r)$ for the seller and a payoff $d(r) - r$ for the buyer, or the seller offers to renegotiate. In this case the game continues. In stage 5 the buyer either rejects renegotiation, leading to payoffs $s - d(r)$ for the seller and $d(r) - r$ for the buyer, or she accepts to renegotiate and offers a new exchange price p_b. In stage 6 the seller chooses between three alternatives. i) He rejects the buyer's offer p_b and gives the good to the third party which leads to payoffs

$s - d(r)$ for the seller and $d(r) - r$ for the buyer. ii) He accepts the buyer's offer and they exchange the good, generating payoffs p_b for the seller and $v(r) - r - p_b$ for the buyer. iii) He continues the bargaining process by asking a new exchange price p_s. This leads to the 7th and last stage of our game. Since the end of the game approaches, buyer and seller get impatient, i.e., they discount any payments that accrue in the last stage by a common discount factor $\delta \leq 1$. If the buyer rejects the seller's offer p_s, payoffs are $\delta(d(r) - r)$ for the buyer and $\delta(s - d(r))$ for the seller. If the buyer accepts, payoffs are $\delta(v(r) - r - p_s)$ for the buyer and δp_s for the seller.

This rather special renegotiation procedure was chosen for the following reasons. If the agents reach an agreement in stage six, the outcome is efficient in the sense that they do not throw away surplus due to discounting. That is, each agent does not necessarily bear a positive cost in the process as is the case in Shavell (1984). If the agents carry on into stage seven, bargaining becomes costly because the pie begins to shrink, i.e., the agents incur transactions costs. Accordingly, our process is not costless forever as is the case in Rogerson (1984). As we will show below, by the fact that bargaining may take several rounds and become costly, the discount factor determines the agents' shares of the surplus. This allows for comparative statics exercises with respect to relative bargaining strengths and some insights in the notion of transactions costs. If we had modelled the renegotiation by, say, a simple take-it-or-leave-it procedure, one agent typically appropriates the entire surplus so that statements about the effects of relative bargaining strengths are not readily possible.

For this multi-stage game we adopt the sequential equilibrium concept as developed by Kreps and Wilson (1982). We will focus on equilibria in pure strategies. We restrict the agents' beliefs to reflect any dominant strategy of their respective opponent.

IV. Equilibrium Results

Let us start with a brief analysis of the renegotiation game of stages $5-7$. A full analysis is relegated to the Appendix. Let $v(r) \geq d(r)$, a requirement that all damage measures we will analyze satisfy. Suppose in equilibrium the seller knows r, thus also $v(r)$ and $d(r)$. Moreover, suppose in equilibrium the seller initiates a renegotiation if and only if $\delta(v(r) - d(r)) \geq s - d(r)$.

Once the agents reach the renegotiation game, the buyer's reliance expenditure r is sunk. That is, her outside option during the renegotiation process is $d(r)$. Suppose in stage 6 the seller demands $p_s = v(r) - d(r)$. In stage 7 the buyer is indifferent between accepting and rejecting this offer. Thus, she accepts. Asking this price in stage 6 generates a stage 7 payoff $\delta(v(r) - d(r))$ for the seller. If the buyer offers $p_b = \delta(v(r) - d(r))$ in stage 5, in stage 6 the seller is indifferent between accepting this offer and continuation of bargaining, and he prefers either alternative to his outside option $s - d(r)$. Consequently, he accepts. If the buyer offers this price in stage 5, her payoff is $(1-\delta)v(r) + \delta d(r)$. Since $v(r) \geq d(r)$, the buyer prefers renegotiation to her outside option $d(r)$.

To summarize: If $\delta(v(r) - d(r)) \geq s - d(r)$, it is efficient to allocate the good to the buyer and the agents manage to do so. The parties reach an agreement in stage 6, i.e., they do not dump surplus through costly bargaining. The buyer gets $v(r) - \delta(v(r) - d(r))$ and the seller $\delta(v(r) - d(r))$ of the pie $v(r)$. The seller's share decreases with the buyer's outside option $d(r)$. Being impatient is bad for the seller. The more the seller discounts stage 7 payments, the less the buyer must offer him in stage 5. Accordingly, the buyer's net payoff from renegotiation is $v(r) - \delta(v(r) - d(r)) - r$ and the seller's payoff is $\delta(v(r) - d(r))$.

Let us now establish equilibrium reliance choices and allocation decisions under various exogeneous damage measures. We want to start with the rule of no damages $d(r) = 0 \quad \forall r \geq 0$.

Proposition 2: *Under the rule of no damages $d(\cdot) = 0$ there exists a sequential equilibrium where the buyer engages in some $r \in [0, \bar{r})$. If the buyer picks a positive reliance level, she gets the good less often than is efficient.*

Proof: The buyer's outside option in the renegotiation game equals 0. Accordingly, she offers the price $p_b = \delta v(r)$ generating the payoff $(1-\delta)v(r) - r$.

Now suppose the seller believes with probability 1 that the buyer picked some pure strategy $\hat{r}$. Accordingly, the seller believes to get payoffs $\delta v(\hat{r})$ from renegotiating, p from performing, and s from giving the good to the outside agent. If $p > \delta v(\hat{r})$, the seller prefers performance to renegotiation. He performs if $s < p$.

The buyer's problem in stage 2 is to find the reliance level $\tilde{r} = \tilde{r}(p)$ that maximizes $(v(r) - p) \int_0^p f(s)ds - r$. If $\tilde{r}$ is such that $\delta v(\tilde{r}) < p$, there exists an equilibrium where the buyer picks $\tilde{r}$ and the seller never renegotiates. Since the buyer voluntarily signed the contract, we have $p \leq v(\tilde{r}) - \tilde{r}$ and thus $\int_0^p f(s)ds < 1$. Consequently, $\tilde{r} \in [0, \bar{r})$. Furthermore, the outside agent gets the good too often. If $\tilde{r}$ is such that $\delta v(\tilde{r}) \geq p$, there exists no equilibrium where the seller performs under the contract.

If $\delta v(\hat{r}) \geq p$, the seller prefers renegotiation to performance. He renegotiates if $s \leq \delta v(\hat{r})$. The buyer has to find the reliance level $\tilde{r} = \tilde{r}(\delta v(\hat{r}))$ that maximizes $g(r) \equiv (1 - \delta)v(r) \int_0^{\delta v(\hat{r})} f(s)ds - r$. If $\tilde{r} = \hat{r}$ and $\delta v(\tilde{r}) \geq p$, there exists an equilibrium where the buyer picks $\tilde{r}$ and the seller never performs, i.e., he breaks and pays damages or he renegotiates. Note that the buyer will never sign a contract with $p > v(\tilde{r})$. This implies that such an equilibrium exists for $\tilde{r} = 0$.

If $\delta = 1$, the seller's allocation decision is efficient, yet $\tilde{r} = 0$. If $\delta = 0$, the seller never renegotiates, hence $\tilde{r} = 0$. If $\delta \in (0, 1)$, the outside agent gets the good too often. If $\delta \in (0, 1)$, $g'(\cdot) < \phi'(\cdot)$. Thus, $g'(r) < 0 \quad \forall r \geq \bar{r}$. Consequently, $\tilde{r} \in [0, \bar{r})$.

Q.E.D.

This result may be explained as follows. If there is renegotiation, the seller gets a payoff $\delta v(r)$ from the procedure because the buyer's outside option is 0 under no damages. If $\delta v(r) < p$, the seller will never renegotiate because he gets more by allocating the good to the buyer by performance under the contract. The buyer voluntarily signed the contract. Accordingly, $p \leq v(r) - r$. The seller allocates the good to the outside agent if $s > p$, i.e., more often than is efficient. Since this also implies that the buyer does not get the good for sure, she picks a reliance level $r < \bar{r}$.

If $\delta v(r) \geq p$, the seller allocates the good to the buyer through renegotiation rather than performance. The outside agent gets the good if $s > \delta v(r)$. If $\delta = 1$, the seller gets the entire pie and his allocation decision is efficient. Yet the buyer will pick $r = 0$ in the first place. If $\delta = 0$, the outside agent always gets the good and the buyer will not rely. If $\delta \in (0, 1)$, the seller's allocation decision is inefficient. The buyer gets a fraction of the surplus $v(r)$. Thus, she will engage in a reliance level $r < \bar{r}$ — the level she would choose if she got the entire pie for sure.

To summarize: Under the rule of no damages the buyer takes into account that she might not get the good. That is, she does not pick the reliance level $\bar{r}$. The seller's allocation decision is efficient if and only if he reaps the entire surplus $v(r)$ in a renegotiation. Yet in this case the buyer will not rely. Otherwise, the seller allocates the good too often to the outside agent.

Next let us consider the reliance measure $d(r) = r \quad \forall r \geq 0$. This measure compensates the buyer for reliance expenditures made in anticipation of performance. The buyer is put in the position she would have been in had she not signed the contract.

Proposition 3: *Under the reliance measure $d(r) = r \quad \forall r \geq 0$ there exists a sequential equilibrium where the buyer picks $\bar{r}$. Given the buyer's excessive reliance choice, the seller's allocation decision is efficient iff $p = v(\bar{r}) - \bar{r}$ or $\delta = 1$. Otherwise, the outside agent gets the good too often.*

Proof: The buyer's outside option in the renegotiation game is r. Accordingly, she offers the price $p_b = \delta(v(r) - r)$. Under the reliance measure the buyer's payoffs are $v(r) - r - p$ if the seller performs, $(1 - \delta)(v(r) - r)$ if the seller renegotiates, and 0 if the outside agent gets the good. These payoffs are maximized by the reliance level $\bar{r}$, independent of δ and the seller's beliefs and actions.

The seller's beliefs reflect the buyer's dominant reliance choice. Suppose $\delta(v(\bar{r}) - \bar{r}) \geq p$, i.e., the seller prefers renegotiating to performing. The seller allocates the good to the outside agent and pays damages if $s - \bar{r} > \delta(v(\bar{r}) - \bar{r})$. If $\delta = 1$, the allocation decision is efficient. If $\delta < 1$, the outside agent gets the good too often because $\phi(\bar{r}) > 0$.

If $p > \delta(v(\bar{r}) - \bar{r})$, the seller prefers performing to renegotiating. The seller allocates the good to the outside agent if $s - \bar{r} \geq p$. If $p = v(\bar{r}) - \bar{r}$, the seller's allocation decision is efficient. If $p < v(\bar{r}) - \bar{r}$, the outside agent gets the good too often. A contract specifying $p > v(\bar{r}) - \bar{r}$ would not have been signed by the buyer beforehand.

Q.E.D.

This result may be explained as follows. Under the reliance measure the buyer's outside option during the renegotiation process is r. Accordingly, she gets the payoffs $(1-\delta)(v(r) - r)$ from renegotiation, $v(r) - r - p$ from performance, and 0 if she is bumped. These payoffs are maximized by the reliance level $\bar{r}$. Since the buyer is compensated for her reliance expenditure if she does not get the good, she considers reliance as an investment in which at worst she will break even. She takes into account the upside potential but ignores the downside risk. Consequently, she chooses the same reliance level as if she got the good for sure, i.e., she overrelies.

The seller gets p if he performs and $\delta(v(\bar{r})-\bar{r})$ if he renegotiates. Allocating the good to the outside agent generates a payoff $s-\bar{r}$. Obviously, the seller allocates the good efficiently if and only if he appropriates the entire surplus $v(\bar{r})-\bar{r}$, i.e., if $p=v(\bar{r})-\bar{r}$ or $\delta=1$. Otherwise, the outside agent gets the good too often. If the seller gets less than $v(\bar{r})-\bar{r}$, giving the good to the outsider may be more attractive even though $s<v(\bar{r})$. Loosely speaking, the seller must compensate the buyer in any case for her reliance investment $\bar{r}$. Therefore, the seller allocates to the outside agent whenever s exceeds his share of the pie $v(\bar{r})$.

Under the reliance measure, as well as under no damages, if $\delta<1$, the seller allocates inefficiently even though the parties may renegotiate. If the parties renegotiate, they reach an agreement immediately and, therefore, in equilibrium incur no transactions costs. Yet the out-of-equilibrium transactions costs determine the seller's share of the renegotiation surplus. The more impatient the seller, the higher the buyer's threat of carrying on bargaining, the lower is the seller's share. The lower the seller's share, the more often the outsider gets the good even though this is inefficient.

Note that in our framework the buyer does not pick a reliance level in excess of $\bar{r}$ as is the case in Shavell (1980) and Rogerson (1984). Shavell and Rogerson assume that the seller observes r at the time he decides about performance. The buyer commits to a reliance level in excess of $\bar{r}$ to increase the probability of performance. In our framework the seller does not observe the buyer's reliance choice. By changing r the buyer does not alter the seller's beliefs and thus the probability of performance. Therefore, a reliance level greater than $\bar{r}$ is unattractive for the buyer. This observation shows the extent to which in particular Rogerson's Pareto-rankings of various damage measures depend on the assumption that the seller observes the buyer's reliance choice.

To summarize: Under the reliance measure the buyer overrelies because at worst she will break even on her investment. If the seller does not appropriate the entire surplus from exchange with the buyer, the outside agent gets the good too often.

Next let us consider the expectation measure $d(r)=v(r)-p \quad \forall r\geq 0$. Under this measure the seller pays an amount that puts the buyer in the position she would have been in had the contract been performed.

Proposition 4: *Under the expectation measure* $d(\cdot) = v(\cdot) - p$ *there exists a sequential equilibrium where the buyer picks* $\bar{r}$. *Given the buyer's excessive reliance choice, the seller's allocation decision is efficient.*

Proof: The buyer's outside option in the renegotiation game is $v(r) - p$. Accordingly, she offers $p_b = \delta p$. Under the expectation measure the buyer's payoffs are $v(r) - r - p$ if the seller performs, $v(r) - r - \delta p$ if the seller renegotiates, and $v(r) - r - p$ if the outside agent gets the good. These payoffs are maximized by the reliance level $\bar{r}$, independent of δ and the seller's beliefs and actions.

The seller's beliefs reflect the buyer's dominant reliance choice. If the seller performs, his payoff is p. If he renegotiates, he gets δp. Thus, the seller never renegotiates. The outside agent gets the good if $s - (v(\bar{r}) - p) > p$ or $s > v(\bar{r})$, i.e., the seller's allocation decision is efficient.

Q.E.D.

Under the expectation measure the buyer's outside option in the renegotiation process is $v(r) - p$. Accordingly, she offers the price $p_b = \delta p$. She gets the payoffs $v(r) - r - p$ if the seller performs, $v(r) - r - \delta p$ if the seller renegotiates, and $v(r) - r - p$ if she is left empty-handed. These payoffs are maximized by the reliance level $\bar{r}$. Under the expectation measure the buyer is guaranteed her valuation $v(r)$. She considers reliance as an investment with a certain payoff and chooses reliance as if she got the good for sure, i.e., she overrelies.

The expectation measure puts the buyer in such a strong bargaining position that the seller's payoff from renegotiation $\delta p \leq p$. Thus, the seller will never renegotiate, i.e., either he performs or he pays damages. If he allocates the good to the outside agent, he has to compensate the buyer for her valuation $v(\bar{r})$. Consequently, he will do so if and only if $s > v(\bar{r})$

To summarize: Under the expectation measure the buyer overrelies because she is guaranteed her valuation $v(r)$. The seller's allocation decision is efficient given the buyer's excessive reliance choice.

The last two Propositions imply the following Corollary.

Corollary: *The equilibrium we derived under the expectation measure is Pareto superior to the equilibrium we derived under the reliance measure.*

Proof: Both measures give rise to the same reliance choice $\bar{r}$. Given this excessive reliance, the seller's allocation decision under the expectation measure is always efficient. Under the reliance measure the seller allocates efficiently if and only if he appropriates the entire surplus $v(\bar{r}) - \bar{r}$.

Q.E.D.

Let us finally derive a class of damage measures that implement the efficient reliance level r^* as well as the efficient allocation decision in our game. To induce the buyer to pick r^* these damage measures take a maximum at r^*. To induce efficient breach, the seller must pay the same amount as under expectation damages given that the buyer picks r^*.

Proposition 5: *Under any damage measure $d(\cdot)$ with $d(\cdot)$ non-decreasing for $r < r^*$, $d(\cdot)$ non-increasing for $r \geq r^*$, and $d(r^*) = v(r^*) - p$ there exists a sequential equilibrium where the buyer picks r^* and the seller's allocation decision is efficient.*

Proof: Suppose the seller believes with probability 1 that the buyer picked r^* and thus that he has to pay $v(r^*) - p$, i.e., the same amount as under expectation damages. Accordingly, he never renegotiates and allocates the good to the outside agent if $s > v(r^*)$.

The buyer then has to find the reliance level that maximizes

$$\left[\left(v(r) - p\right) \int_0^{v(r^*)} f(s)ds - r\right] + d(r) \int_{v(r^*)}^{\bar{s}} f(s)ds$$

which is obviously maximized by r^*. That is, the buyer picks r^* and the seller's beliefs are borne out.

Q.E.D.

This result is easily explained. Suppose the seller believes that the buyer picked the efficient reliance level r^* and thus that he has to pay the same amount as under expectation damages. This implies that the seller never renegotiates. Either he performs or he pays damages. The seller allocates efficiently, i.e., the outside agent gets the good if $s > v(r^*)$.

Given the seller's beliefs and behavior, the buyer's maximization problem is the sum of two terms. The first term is her expected payoff from performance minus her reliance expenditure. Since the seller performs efficiently, this term is maximized by r^*. The second term is the expected damages the buyer receives. By construction, they take a maximum at r^*. Consequently, the buyer picks r^* and the seller's beliefs are borne out.

Note that this class of efficient damage measures contains the remedy proposed by Cooter (1985), namely constant damages $d(r) = v(r^*) - p$.[5] In the following discussion we will focus on this particular example. One might argue that the constant damages rule requires the courts to know the function $v(\cdot)$ and the density $f(\cdot)$ in order to compute $v(r^*)$. Under the other damage measures the courts assess one particular value r or $v(r)$. Yet this need not be the case. Our entire analysis is based on the assumption that the buyer and the seller know the technological setup and thus the valuation $v(r^*)$. The reason why they do not write a complete contingent contract is that the buyer cannot observe the realization of the outside bid. Suppose the above rule requires that the parties include in the contract constant damages. The buyer and the seller will happily choose $v(r^*)$ so as to maximize the ex ante surplus from their relationship. In case of breach a judge has simply to enforce the payment specified in the contract. Therefore, constant damages do not require that the courts know more of the nature of contractual situations than the other damage measures do. Yet with this interpretation the rule requires that the parties incorporate more information in the contract. Shavell (1980) shows that there does not exist a damage measure that induces efficient behavior. To prove this impossibility theorem, Shavell rules out the inclusion of information contained in $v(r^*)$ (or alternatively r^*) in the contract. Accordingly, there is no conflict between our and Shavell's result. To establish Proposition 5 we allow the parties to write a contract that is 'less incomplete' than the contracts in Shavell's setup.[6]

V. Conclusions

The purpose of this exercise is to clarify the strategic role of damage measures in contractual situations where renegotiation may occur. We have argued that damage measures determine the agents' outside options in the renegotiation process. Our particular renegotiation procedure is characterized by the following efficiency properties. Once the agents have reached the renegotiation game, they manage to allocate the good efficiently to the buyer. Moreover, the agents do not dump surplus through costly bargaining. Nevertheless, the seller may not initiate a renegotiation often enough because his share of the surplus, which is determined by the out-of-equilibrium transactions costs, is less than what he gets elsewhere. Under the rule of no damages and the reliance measure the seller's allocation decision typically is inefficient. Therefore, one should be reluctant to claim that the possibility of renegotiation induces efficient ex post allocation decisions.

Notice that the inefficiencies do not result from the incomplete and imperfect information we start out with. In the equilibria we consider, all relevant information is revealed at the time renegotiation starts. Accordingly, it is only the fact that the seller is impatient and, therefore, does not appropriate the entire surplus that induces him not to renegotiate often enough.

We have made our point by means of a simple example. Accordingly, one should be careful in generalizing in particular our results on the relative efficiency of the various damage measures. All of our results depend on the chosen sequencing of moves in the game. An analysis of the problem that is independent of ad hoc specified game structures requires methods of mechanism design. This remains an interesting topic for future research.

Appendix

In this appendix we provide a rigorous analysis of the renegotiation subgame. First consider the case $\delta(v-d) < s-d$. If $p_b \geq s-d$, the seller accepts p_b. This generates payoffs p_b for the seller and $v-r-p_b$ for the buyer. If $p_b < s-d$, the seller quits bargaining, leading to payoffs $s-d$ for the seller and $d-r$ for the buyer.

Next consider the case $\delta(v-d) \geq s-d$. If $p_b \geq \delta(v-d)$, the seller accepts p_b, generating payoffs p_b for the seller and $v-r-p_b$ for the buyer. If $p_b < \delta(v-d)$, the seller makes the counteroffer $p_s = v-d$. This leads to payoffs $\delta(v-d)$ for the seller and $\delta(d-r)$ for the buyer.

Let $q(s)$ be the probability that the seller offers renegotiation in stage 4. Let $\pi(s, p_b)$ be the probability that the seller accepts p_b in stage 6. From the preceding analysis we have that in equilibrium

$$\pi(s,p_b) = \begin{cases} 0, & \text{if } p_b < \delta(v-d) \text{ and } s \leq \delta v + (1-\delta)d; \\ 0, & \text{if } p_b < s-d \text{ and } s > \delta v + (1-\delta)d; \\ 1, & \text{otherwise.} \end{cases} \tag{$\dagger$}$$

Accordingly, the buyer's expected payoff from offering p_b is over the interval $\big[0, \delta(v-d)\big)$

$$\begin{aligned} U(p_b) = &(d-r)\int_{\delta v+(1-\delta)d}^{\bar{s}} q(s)f(s)ds + \\ &\delta(d-r)\int_0^{\delta v+(1-\delta)d} q(s)f(s)ds + (d-r)\int_0^{\bar{s}} \big(1-q(s)\big)f(s)ds \end{aligned}$$

and over the interval $[\delta(v-d), \infty)$

$$\begin{aligned} U(p_b) = &(v-r-p_b)\int_0^{p_b+d} q(s)f(s)ds + \\ &(d-r)\int_{p_b+d}^{\bar{s}} q(s)f(s)ds + (d-r)\int_0^{\bar{s}} \big(1-q(s)\big)f(s)ds \end{aligned}$$

or

$$U(p_b) = \begin{cases} (d-r) + (\delta-1)(d-r)\int_0^{\delta v+(1-\delta)d} q(s)f(s)ds, & \text{if } p_b < \delta(v-d); \\ (d-r) + (v-r-p_b)\int_0^{p_b+d} q(s)f(s)ds, & \text{otherwise.} \end{cases}$$

Obviously, $U(\delta(v-d)) \geq \sup \text{range } U|_{[p_b<\delta(v-d)]}$. Consequently, the buyer will never offer $p_b < \delta(v-d)$.

Consider now the seller's payoffs. If $s > d + \max[p_b, \delta(v-d)]$, his expected payoff is $s-d$, independent of whether he quits bargaining in stage 4 or 6. Accordingly, any $q(\cdot)$ can be his equilibrium choice. If $s \leq d+\max[p_b, \delta(v-d)]$, his expected payoff is $\max[p_b, \delta(v-d)]$. Consequently, in equilibrium he will pick $q(s) = 1$.

A sequential equilibrium for the subgame starting in stage 4 is a triple p_b, $q(\cdot)$, and $\pi(\cdot)$ such that $p_b \in \arg\max U(\cdot)$,

$$q(s) = \begin{cases} 1, & \text{if } s \leq p_b + d; \\ 0, & \text{otherwise,} \end{cases}$$

and $\pi(\cdot)$ defined by (†).

A price $p_b \in [\delta(v-d), \infty)$ is an equilibrium if and only if $\forall \hat{p}_b \in [\delta(v-d), p_b]$

$$(v - p_b - d) \int_0^{p_b+d} f(s)ds \geq (v - \hat{p}_b - d) \int_0^{\hat{p}_b+d} f(s)ds.$$

This implies $p_b \leq v - d$. Furthermore, if $U(\cdot)$ is decreasing on $[\delta(v-d), v-d]$, the unique equilibrium price is $p_b = \delta(v-d)$.

Footnotes

1) By slightly modifying the model we may interpret s as the seller's production cost. For the alternative bid interpretation we assume that the buyer has no option to resell the item to the outsider.

2) See Shavell (1984) for a similar renegotiation procedure.

3) Note that in Shavell's (1980) and Rogerson's (1984) analysis the seller observes the buyer's choice of r. Accordingly, they study the perfect information case.

4) Whenever we state payoffs, the agents have reached a terminal node, i.e., the game is over.

5) See also Finsinger and Simon (1988).

6) Stole (1989) shows that contractually stipulated damages, commonly known as liquidated damages, will be set at under-compensatory levels when traders have private information about their valuations. The loss from excessive breach is offset by the informational gains at the pre-contractual stage.

References

1. R. COOTER, Unity in Tort, Contract, and Property: The Model of Precaution, *Cal. Law Review* 73 (1985), 1 - 51.
2. J. FINSINGER AND J. SIMON, "The Optimal Damage Rule for Breach of Contract", Arbeitsbericht 42, Hochschule Lüneburg (1988).
3. B. KLEIN, R. G. CRAWFORD, AND A. A. ALCHIAN, Vertical Integration, Appropriable Rents, and the Competitive Contracting Process, *J. Law Econ.* **21**, 297 - 326.
4. L. A. KORNHAUSER, Reliance, Reputation, and Breach of Contract, *J. Law Econ.* **26** (1983), 691 - 706.
5. D. M. KREPS AND R. WILSON, Sequential Equilibria, *Econometrica* **50** (1982), 863 - 894.
6. W. P. ROGERSON, Efficient Reliance and Damage Measures for Breach of Contract, *Rand J. Econ.* **15** (1984), 39 - 53.
7. S. SHAVELL, Damage Measures for Breach of Contract, *Bell J. Econ.* **11** (1980), 466 - 490.
8. S. SHAVELL, The Design of Contracts and Remedies for Breach, *Quart J. Econ* **98** (1984), 121 - 148.
9. L. A. STOLE, "The Economics of Liquidated Damage Clauses in Contractual Environments with Private Information", mimeo, Department of Economics, MIT (1989).