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ON THE EFFICIENCY OF PRIVATELY STIPULATED DAMAGES FOR BREACH OF CONTRACT: ENTRY BARRIERS, RELIANCE, AND RENEGOTIATION

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ABSTRACT

Two roles for stipulated damage provisions have been debated in the literature: protecting relationship-specific investments and inefficiently excluding competitors. Aghion and Bolton (1987) formally demonstrate the latter effect in a model without investment or renegotiation. While introducing renegotiation alone destroys their result, introducing both renegotiation and investment restores it. In particular, if the entrant has market power, then privately stipulated damages are socially excessive, and the seller over-invests relative to the social optimum. In contrast, if the entrant prices competitively (as typically is assumed in the Law and Economics literature on breach), then private stipulation is efficient. While a simple legal restriction on the contract corrects for any inefficiency, the standard court-imposed remedies do not.

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INTRODUCTION

A feature of many supply contracts is the stipulation of damages to be paid in the event of breach by one of the parties. The Industrial Organization literature contains two quite divergent views of these damage provisions. One school of thought has emphasized the importance of these provisions for protecting relationship-specific investments, or as they are called in the legal literature, reliance expenditures. The other, arising from antitrust cases such as *United Shoe Machinery*[1], has argued that these provisions may be used to inefficiently exclude competitors.[2]

In a provocative recent paper, Aghion and Bolton (1987) provide a formal demonstration that stipulated damage provisions in contracts can serve as inefficient barriers to entry.[3] They show that in circumstances where an entrant will have some market power, so that its price need not equal its cost, the buyer and incumbent seller have a joint incentive to write a contract that stipulates a socially excessive level of damages. They do so because by committing to a high level of damages, the buyer's reservation price for the entrant's product is lowered, and the entrant must lower its price if it is to make a sale. As a result, the likelihood of entry is reduced below the socially efficient level.

Aghion and Bolton's argument, however, suffers from an apparent problem: if the buyer and seller can renegotiate the terms of their contract, the commitment power of the original contract, which is essential to their result, may be lost. This has led some to doubt the likelihood of inefficiencies arising from the strategic use of stipulated damages, especially since stipulated damages often appear to protect relationship-specific investments by one or both of the parties to the contract

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[1] United States v. United Shoe Mach. Corp., 110 F. Supp. 295 (D. Mass. 1953), *aff'd per curiam*, 347 U.S. 521 (1954).

[2] For a general discussion of these two views, see Williamson (1985, pp. 23-29) and Masten and Snyder (1989).

[3] Diamond and Maskin (1979) explore similar issues.

(see Masten and Snyder (1989) for an argument along these lines).[4]

In this paper, we study a model that introduces both reliance expenditures and renegotiation into Aghion and Bolton's analysis. After the buyer and seller sign their initial contract (but before the entrant appears) the seller may invest to reduce his costs of serving the buyer. In addition, once the entrant has made a price offer to the buyer, the buyer and seller can renegotiate the terms of their original contract.

We show that while the introduction of renegotiation alone would destroy Aghion and Bolton's results, renegotiation does *not* vitiate the strategic use of stipulated damage provisions in the presence of relationship-specific investment. Interestingly, it is precisely the feature that Aghion and Bolton's critics point to as evidence that a stipulated damage provision is serving an efficient purpose that maintains the strategic use of excessive stipulated damages when renegotiation is possible.

Our analysis is also closely related to recent work in the Law and Economics literature. In that literature, the central focus has been on the efficiency of standard court-imposed damage measures in the case where the buyer's alternative source of supply (the entrant) is competitively priced. Shavell (1980) initiated the study of this problem by considering the case where the initial contract cannot be renegotiated, while Rogerson (1984) extended Shavell's analysis to the case where the buyer and the seller can renegotiate the terms of their original contract. In both settings, the standard court-imposed damage measures generally lead to over-investment. In contrast, our analysis, and a recent paper by Chung (1992) where renegotiation is impossible, focusses on the efficiency of privately stipulated damages.

The paper is organized as follows. Section I introduces the model. There we also

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[4] For a recent alternative view, however, see Brodley and Ma (1993). Both Brodley and Ma and Masten and Snyder (1989) also present a discussion of antitrust cases involving contractual penalties for breach of contract.

characterize the socially efficient contract and provide a preliminary characterization of the payoffs resulting from *ex post* renegotiation.

In Section II, we study the case of a competitive entrant whose price is equal to its cost. Since no externalities are present (the entrant always earns zero profits), the buyer and seller necessarily have a joint incentive to implement the socially efficient outcome. We show that in such settings, a simple stipulated damage provision, which we call *efficient expectation damages*, succeeds in implementing this outcome. Hence, in the case of a competitive entrant, stipulated damage provisions are written to protect the seller's reliance to just the right degree. Taken together with Chung's results, this establishes that in the settings studied by Shavell and Rogerson there is no justification for court interference with the private stipulation of damages.

Section III contains our analysis of the case of a non-competitive entrant. There we assume, as in the Aghion-Bolton model, that the entrant is able to make a take-it-or-leave-it offer to the buyer. We first show that, in the absence of reliance expenditures, renegotiation between the buyer and seller vitiates the strategic use of contracts and the socially efficient outcome results. We then establish our main result: when the seller makes reliance expenditures, the buyer and seller will stipulate a socially excessive level of damages for breach of contract. The source of this distortion is a fundamental externality between the extent of the seller's reliance and the entrant's price offer: the lower is the seller's cost, the lower must be the entrant's offer if it is to make a sale. The buyer and seller therefore have a joint incentive to encourage a socially excessive level of investment, and stipulating excessively high damages can accomplish this goal. Thus, in principle, the presence of a non-competitive entrant provides a justification for court intervention into private contracting.[5]

[5] Aghion and Hermalin (1987) establish a different rationale for legal restrictions on private contracts. In their model, private information at the time of contracting may lead to costly signalling through high penalty clauses, and legal restrictions can increase social welfare by inducing a pooling outcome instead. Other papers that address the scope for legal restrictions on private contracts include Hermalin and Katz (1992) and Stole (1992).

Section III also considers potential remedies for this problem. We first show that the efficient expectation damage measure implements the socially efficient outcome in the case of a non-competitive entrant. However, because implementation of this damage measure would require that the court have knowledge of the prior distribution of the entrant's cost realization, as well as the functional relationship between the seller's reliance and its costs, we also study the outcomes under some standard court-imposed rules, which depend only on realized costs or reliance levels. We show that none of these standard rules help to correct the inefficiency of private damage stipulation, and they may even worsen it.

The conclusion discusses some extensions of our model, including the case where the entrant has some but not all of the bargaining power. (The formal analysis for this intermediate case is presented in the appendix.) We also discuss some reinterpretations of our model to other settings, such as franchise regulation and golden parachutes in executive compensation contracts.

I. THE MODEL

A seller (S) and a buyer (B) write a contract for the future delivery of an indivisible good. The buyer's commonly-known valuation of the good is v. The contract, which we denote by $\langle p_0, p_1 \rangle$, specifies a price that the buyer will pay the seller for the delivery of the good, p_1, and the amount that the buyer must compensate the seller if he breaches the contract and refuses delivery, p_0. We will refer to p_0 as the "stipulated damage clause." Since the seller and the buyer have symmetric information at the time of contracting, they will write a contract that maximizes their expected joint payoff, perhaps using an up-front transfer to allocate the surplus.[6]

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[6] As will be made clear later, only the difference, $p_1 - p_0$, is relevant for behavior under the contract; adding a constant to both p_1 and p_0 can therefore be used to allocate the surplus. One might wonder whether the parties could benefit from writing more complicated contracts. As we

After the contract is in place, the seller makes a relationship-specific reliance expenditure, r, which influences his cost of producing the good, $c_S(r)$. We assume that this cost is decreasing and convex in r, and that $c_S(0) < v$.[7] The seller's investment decision and the associated cost are assumed to be observable but not contractible; although the buyer observes the seller's choice of r, the seller cannot contractually bind himself to a particular reliance level.[8] After the seller chooses his reliance level, an alternative supplier, who we refer to as the "entrant" (E), appears. The entrant is characterized by a cost of production, c_E, which is drawn from a density function f(c) with support [0, v]. The cumulative distribution function is denoted F(c).

The entrant observes the incumbent seller's cost and the contract $\langle p_0, p_1 \rangle$, and announces a price, p_E.[9] In Section II we assume that the entrant faces a competitive constraint in setting his price, and so p_E equals the entrant's per unit cost c_E. For example, there may actually be many entrants, each with cost c_E. In contrast, in Section III we assume that the entrant possesses market power, and is able to make a take-it-or-leave-it offer to the buyer.

After the entrant announces his price but before the buyer decides from whom to buy the good, the buyer and the seller may renegotiate their original contract. We adopt the generalized Nash bargaining solution, where the renegotiation is assumed to result in an outcome that is jointly efficient for the buyer and the seller. The seller receives a proportion $\alpha \in [0, 1]$ of the additional

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show below, the parties can achieve their most preferred outcome using a contract with this simple form.

[7] With this assumption trade is always efficient; the only question is whether the buyer should procure from the seller or the entrant. We make this assumption so as to focus only upon the buyer's breach decision.

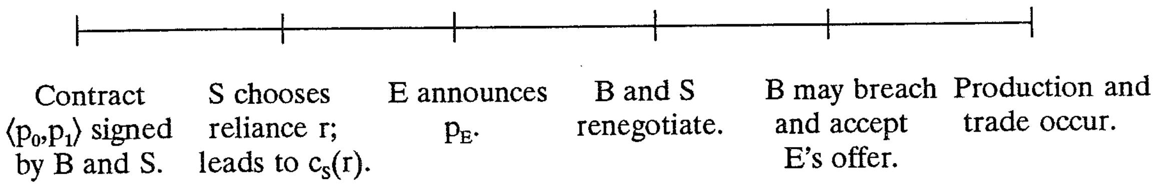
[8] This type of noncontractible decision is often referred to as "observable but not verifiable."

[9] Whether the entrant observes the existing contract between the buyer and the seller is actually immaterial for our results.

surplus generated as a result of renegotiation, and the buyer receives proportion $(1-\alpha)$.[10]

The timing of the model is therefore as described in Figure 1.

Figure 1



As a benchmark, it is useful to identify the socially optimal outcome of the model. Efficiency calls for the entrant to supply the good when $c_S(r)$ exceeds c_E, and for the incumbent seller to supply it otherwise. In addition, the socially optimal level of reliance, which we denote by r^*, maximizes aggregate social welfare:

$$S(r) = v - \int_0^{c_S(r)} c_E f(c_E) dc_E - [1 - F(c_S(r))]\, c_S(r) - r . \tag{1}$$

The first-order necessary condition for r^* is given by:

$$S'(r^*) = - c_S'(r^*)\, [1 - F(c_S(r^*))] - 1 = 0 . \tag{2}$$

Intuitively, the social benefits of the seller's investment accrue only when $c_S(r^*) < c_E$, so the expected marginal benefits are $-c_S'(r^*)[1 - F(c_S(r^*)]$. The marginal cost of reliance, which is equal to 1, is incurred regardless of the realization of c_E. We will assume that $S(r)$ is strictly concave; that is, that

$$S''(r) = - c_S''(r)\, [1 - F(c_S(r))] + [c_S'(r)]^2 f(c_S(r)) < 0 \tag{3}$$

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10 Although we have adopted a cooperative solution, the results are equivalent to the following noncooperative game: the buyer makes a take-it-or-leave-it offer to the seller with probability $1-\alpha$, and the seller makes an offer with probability α.

for all r. In this case, there is a unique socially efficient level r^*, and it is the sole solution to (2).[11]

The Outcome of Contractual Renegotiation

Renegotiation of the original contract plays a crucial role in determining *ex post* trade. For example, when the entrant sets a price $p_E < c_S$, the buyer and seller have a joint interest in purchasing the good from the entrant -- the cost of acquiring the good from the entrant is smaller than the cost of producing it themselves. If $p_E > p_1 - p_0$, however, then the buyer would not unilaterally breach the original contract even though $p_E < c_S$. This is so because the total cost to the buyer of breaching the contract and purchasing from the entrant is $p_E + p_0$, while the cost of purchasing from the seller specified in the original contract is p_1. Yet, if the buyer and the incumbent seller are free to renegotiate their original agreement, breach will nevertheless occur in the continuation equilibrium. If, on the other hand, $p_E > c_S$, the buyer and seller have a joint interest in producing the good themselves. If $p_E < p_1 - p_0$, however, then the buyer has an incentive to unilaterally breach the original contract. In this case, breach will not occur following renegotiation of the original contract.

Moreover, as we shall see, the prospect of renegotiation can have important effects on the seller's choice of an *ex ante* reliance level. We close this section by establishing a preliminary result giving the outcome of renegotiation for any initial contract $\langle p_0, p_1 \rangle$ with $p_1 - p_0 \leq v$, seller cost c_S, and entrant price p_E.[12] This result finds application in each of the following sections.

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[11] One can verify that this condition is satisfied by the following example: $c_S(r) = 1 - r^\beta$, where $\beta < 1/2$, and c_E is uniformly distributed on the interval [0, 1].

[12] It is not difficult to show that any contract $\langle p_0, p_1 \rangle$ with $p_1 - p_0 > v$ is equivalent to having no contract (if $p_1 - p_0 > v$, it is always in the buyer's interest to breach). We therefore restrict attention to contracts with $p_1 - p_0 \leq v$ henceforth.

LEMMA 1: Given a contract $\langle p_0, p_1 \rangle$, seller cost c_S, and a price offer p_E, the payoffs after renegotiation (exclusive of the seller's reliance expenditures) for the seller, the buyer, and the entrant, respectively, are given by:

(a) $\{p_1 - c_S + \alpha(c_S - p_E),\ v - p_1 + (1-\alpha)(c_S - p_E),\ p_E - c_E\}$ if $p_E \leq c_S$ and $p_E > p_1 - p_0$.

(b) $\{p_0,\ v - p_0 - p_E,\ p_E - c_E\}$ if $p_E \leq c_S$ and $p_E \leq p_1 - p_0$.

(c) $\{p_1 - c_S,\ v - p_1,\ 0\}$ if $p_E > c_S$ and $p_E > p_1 - p_0$.

(d) $\{p_0 + \alpha(p_E - c_S),\ v - p_0 - p_E + (1-\alpha)(p_E - c_S),\ 0\}$ if $p_E > c_S$ and $p_E \leq p_1 - p_0$.

Remark: In Lemma 1 and the analysis that follows, we resolve any indifference in favor of a purchase from the entrant. Thus, the buyer will breach absent renegotiation if and only if $p_E \leq p_1 - p_0$, and renegotiation will result in a purchase from the entrant if and only if $p_E \leq c_S$. These tie-breaking assumptions are, however, inessential for the results that follow.

PROOF: First, suppose that $p_E \leq c_S$. If $p_E > p_1 - p_0$, then absent renegotiation the buyer will purchase from the seller even though their joint payoff is higher if he buys from the entrant; they must renegotiate their original agreement to capture an additional surplus of $c_S - p_E$. Since the buyer will not breach under the original contract, the outside options for the bargaining game are $\{p_1 - c_S, v - p_1\}$ for the seller and buyer, respectively. Bargaining divides the increase in surplus between the two players, giving $\alpha(c_S - p_E)$ to the seller, and $(1-\alpha)(c_S - p_E)$ to the buyer. If, on the other hand, $p_E \leq p_1 - p_0$, then the buyer will breach in the absence of renegotiation. Since $p_E \leq c_S$, breach is efficient and the buyer and seller cannot gain through renegotiation.

Now suppose that the entrant's price is greater than the seller's cost: $p_E > c_S$. It is not in the joint interest of the buyer and seller to purchase the good from the entrant. If $p_E > p_1 - p_0$ then the buyer will not breach under the original contract. However, if $p_E \leq p_1 - p_0$ the buyer will breach under the original contract and renegotiation is necessary to achieve an efficient outcome. The outside options are $\{p_0, v - p_0\}$ for the seller and the buyer, respectively, and the incremental surplus, $c_S - p_E$, is divided between them. □

II. A COMPETITIVE ENTRANT

This section considers an entrant who always offers a price equal to his cost of production: $p_E = c_E$. Since following renegotiation the lowest cost producer will certainly supply the good, the joint *ex post* payoff of the buyer and seller is $v - \min\{c_S, c_E\}$ (this is easily derived from Lemma 1). Hence, the buyer and seller's joint expected payoff is exactly S(r), the social payoff, and their expected joint payoff is maximized by the socially optimal reliance level, r^*. This equivalence arises because the buyer and seller's actions have no external effects (the entrant always earns zero profits).

The interesting question is whether, and how, the buyer and seller can achieve this outcome. It is well-known that in the absence of a contract they generally cannot: when $\alpha < 1$ (i.e. the buyer has some bargaining power) the seller will under-invest, setting $r < r^*$ (see Rogerson (1984)). We now show that there exists a contract $\langle p_0, p_1 \rangle$ that induces the seller to choose reliance level r^*. The optimal contract stipulates a damage payment for breach equal to the *efficient expectation damage*; that is, equal to the level of expectation damages evaluated at the socially efficient reliance level, r^*: $p_0 = p_1 - c_S(r^*)$.[13]

[13] As will be discussed in more detail later, the expectation damage measure leaves the seller as well off as he would have been had the contract been performed by awarding a damage payment of $p_1 - c_S(r)$. As a result, the expectation damage varies with the seller's actual choice of reliance, r. Efficient expectation damages, on the other hand, set $p_0 = p_1 - c_S(r^*)$ and so are independent of the actual level of reliance chosen by the seller.

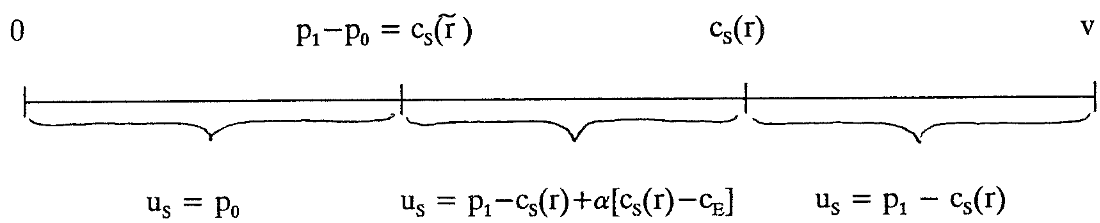
PROPOSITION 1: When the entrant prices competitively, $p_E = c_E$, the contract $\langle p_0, p_1\rangle$ with $p_1 - p_0 = c_S(r^*)$ induces the seller to choose the first-best reliance level, r^*. Moreover, if $p_1 - p_0 < c_S(r^*)$ then the seller invests too much ($r > r^*$), while if $p_1 - p_0 > c_S(r^*)$ then the seller invests too little ($r < r^*$).

PROOF: Given a contract $\langle p_0, p_1\rangle$, define the reliance level $\tilde{r}$ such that $p_0 = p_1 - c_S(\tilde{r})$.

Consider first the case where the seller chooses $r \in [0, \tilde{r}]$, so $c_S(r) \geq p_1 - p_0$. Using Lemma 1, if $c_E \leq p_1 - p_0$, then the seller receives a payoff (exclusive of his reliance expenditure) of p_0; if $p_1 - p_0 < c_E \leq c_S(r)$, then the seller gets $p_1 - c_S(r) + \alpha[c_S(r) - c_E]$; finally, if $c_E > c_S(r)$ the seller gets $p_1 - c_S(r)$. The following diagram depicts the seller's payoff as a function of c_E.

<u>Figure 2</u>

Realizations of c_E:



The seller's expected payoff for $r \leq \tilde{r}$ is given by the function $\pi_L(r)$ ("L" stands for low reliance levels) where:

$$\pi_L(r) = F(p_1 - p_0)p_0 + \int_{p_1-p_0}^{c_S(r)} [p_1 - c_S(r) + \alpha(c_S(r) - c_E)]f(c_E)dc_E + [1 - F(c_S(r))][p_1 - c_S(r)] - r \,. \quad (4)$$

Differentiating this expression with respect to r gives:

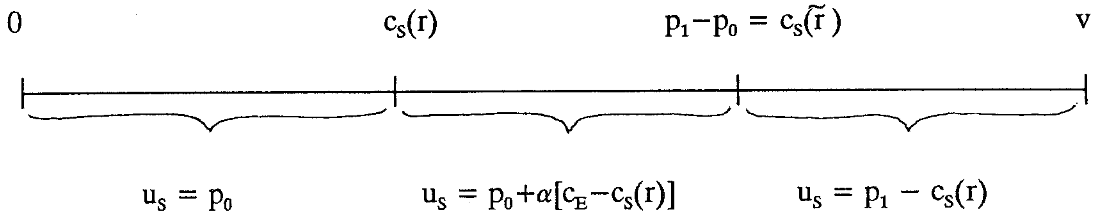
$$\pi_L'(r) = -c_S'(r)\,[1 - \alpha F(c_S(r)) - (1-\alpha)F(p_1 - p_0)] - 1 \,. \quad (5)$$

Note that $\pi_L'(r) > S'(r)$ for all $r < \tilde{r}$ and that $\pi_L'(\tilde{r}) = S'(\tilde{r})$.

Now consider $r \in [\tilde{r}, \infty)$. In this case, $c_S(r) \leq p_1 - p_0$. Using Lemma 1, if $c_E \leq c_S(r)$ then the seller receives a payoff p_0; if $c_S(r) < c_E \leq p_1 - p_0$ then the seller gets $p_0 + \alpha[c_E - c_S(r)]$; finally, if $c_E > p_1 - p_0$ then the seller gets $p_1 - c_S(r)$. The seller's payoff is depicted in the following diagram.

Figure 3

Realizations of c_E:



The seller's expected payoff for these "high" levels of r is given by $\pi_H(r)$ where:

$$\pi_H(r) = F(c_S(r))p_0 + \int_{c_S(r)}^{p_1 - p_0} [p_0 + \alpha(c_E - c_S(r))]f(c_E)dc_E + [1 - F(p_1 - p_0)][p_1 - c_S(r)] - r . \tag{6}$$

Note that $\pi_H(\tilde{r}) = \pi_L(\tilde{r})$. In addition, taking the derivative of $\pi_H(r)$ yields:

$$\pi_H'(r) = -c_S'(r)[1 - \alpha F(c_S(r)) - (1-\alpha)F(p_1 - p_0)] - 1 \tag{7}$$

Hence, $\pi_H'(r) < S'(r)$ for $r > \tilde{r}$, and $\pi_H'(\tilde{r}) = S'(\tilde{r})$.

Suppose, first, that $p_1 - p_0 = c_S(r^*)$; i.e., that $\tilde{r} = r^*$. Then for $r < r^*$ we have $\pi_L'(r) > S'(r) > 0$, while for $r > r^*$ we have $\pi_H'(r) < S'(r) < 0$. Moreover, $\pi_H'(r^*) = \pi_L'(r^*) = S'(r^*) = 0$. Thus, setting reliance equal to r^* is the seller's optimal choice when $p_1 - p_0 = c_S(r^*)$.

If $\langle p_0, p_1 \rangle$ is instead such that $p_1 - p_0 > c_S(r^*)$, then $\tilde{r} < r^*$ and $\pi_H'(r) < S'(r) \leq 0$ for all $r \geq r^*$ and so the seller under-invests. Likewise, if $p_1 - p_0 < c_S(r^*)$, then $\tilde{r} > r^*$ and $\pi_L'(r) > S'(r) \geq 0$ for all $r \leq r^*$ and so the seller over-invests. □

Intuitively, the efficient expectation damage implements r^* for the following reason: if the seller sets r below r^*, then as shown in Figure 2 he earns $[p_1 - c_S(r)]$ when $c_E > c_S(r)$ and he also earns $[p_1 - c_S(r) + \alpha(c_S(r) - c_E)]$ when $c_E \leq c_S(r)$ but $c_E > p_1 - p_0$. By increasing r slightly he gets the full return on his cost reduction in states where $c_E > c_S(r)$, and also captures a share $(1-\alpha)$ of it in states where $c_E \leq c_S(r)$ and $c_E > p_1 - p_0$. But a planner would see the seller's cost reduction as a social gain only in the former set of states: only in these cases does the seller actually end up producing the good. Hence, at $r < r^*$ the seller's incentive to increase reliance that *exceeds* that of the social planner. Similar reasoning reveals that when $r > r^*$, the seller has an incentive to increase r that is *less* than that of a social planner. Together, these factors induce the seller to choose reliance level r^*, the socially efficient level.

The implication of Proposition 1 is that by using a simple stipulated damage provision, the buyer and seller can implement their privately optimal outcome even though reliance is not contractible.[14] In fact, it is straightforward to see that exactly the same contract achieves the efficient outcome in the absence of renegotiation (see Chung (1992)).[15] In particular, absent renegotiation breach occurs if and only if $c_E \leq p_1 - p_0$. Hence, the seller's payoff as a function of r is $[1-F(p_1-p_0)][p_1-c_S(r)] + F(p_1-p_0)p_0 - r$, yielding the first-order condition $-[1-F(p_1-p_0)]c_S'(r) - 1 = 0$. Thus, setting $p_1 - p_0 = c_S(r^*)$ leads the seller to choose reliance level r^*. Moreover, when

[14] Note that what is critical for implementing r^* is that the difference between p_1 and p_0 be set correctly, not their magnitudes per se. The relative bargaining strengths of the seller and buyer at the initial contract formation stage will determine these magnitudes to achieve an appropriate split of the surplus between them.

[15] See Cooter and Eisenberg (1985) for a related analysis. They propose a modified version of expectation damages, where damages are limited to costs that are "reasonable," in order to control the problem of over-reliance.

he does so, the buyer's breach decision is always efficient.[16]

Taken together, these results imply that in the settings considered in the Law and Economics literature by Shavell (1980) and Rogerson (1984), the buyer and seller not only have the incentive to write a socially efficient contract, but also can achieve this goal using a relatively simple contract that stipulates the efficient expectation damage for breach of contract. Hence, in these settings there is no scope for court-imposed damage provisions to improve welfare.

III. A NON-COMPETITIVE ENTRANT

In this section we allow the entrant to behave strategically, setting his price p_E to extract the maximal possible amount of profit. As we shall see, the contracting incentives of the buyer and seller change dramatically, and in equilibrium they will stipulate an inefficiently large penalty for breach of contract.

To begin, consider the entrant's optimal pricing strategy. The entrant chooses his price strategically given his own cost, c_E, and his observation of c_S and $\langle p_0, p_1 \rangle$. Since breach will occur in equilibrium if and only if it is *ex post* efficient for the buyer-seller pair, the entrant will succeed in making a sale if and only if he sets $p_E \leq c_S$.[17] When $c_E < c_S$, the entrant's optimal strategy is to set $p_E = c_S$ and earn $c_S - c_E > 0$. On the other hand, when $c_E > c_S$, the entrant's profit maximizing

[16] Another way to see this result is as a corollary of Proposition 1. The seller's payoff when he chooses r^* and renegotiation is not possible is equal to his payoff from choosing r^* when renegotiation is feasible (since no renegotiation occurs). The seller's payoff from choosing $r \neq r^*$ is no greater in the absence of renegotiation than when renegotiation is possible (since the no-renegotiation payoffs serve as the status quo points in bargaining). Given Proposition 1, r^* must therefore be the seller's optimal choice when renegotiation is not feasible.

[17] Recall that we assumed that breach occurs if $p_E = c_S$. The results do not depend, however, on this resolution of the buyer and seller's joint indifference; we could equally well have breach occur if and only if $p_E < c_S$. In this case, when $c_E < c_S$ the entrant makes an offer arbitrarily close to (but below) c_S, and can earn a payoff arbitrarily close to $c_S - c_E$.

strategy is to choose some price $p_E > c_S$ and receive a payoff of zero. (If the entrant sets $p_E < c_S$, the buyer would breach and the entrant would produce the good and make a negative return). The entrant is indifferent about the precise value for p_E so long as it is higher than c_S. The value is relevant for the buyer and seller, however, since the outcome of their renegotiation may depend upon it. We will focus on the continuation equilibrium where if $c_E > c_S$, then the entrant sets $p_E = c_E$.[18] We have established the following:

LEMMA 2: For any contract $\langle p_0, p_1 \rangle$, a profit-maximizing strategy for the entrant is to set $p_E = c_S$ if $c_E \leq c_S$, and to set $p_E = c_E$ if $c_E > c_S$.

Using Lemma 2, we can immediately see that, in the absence of reliance expenditures (for example if $c_S(r)$ is constant for all r), the entrant's price is unaffected by the buyer and seller's contract (it is set at $p_E = \max\{c_S, c_E\}$ regardless of the contract). Thus, absent reliance, the possibility for renegotiation assumed here completely vitiates the strategic use of contracts derived in Aghion and Bolton (1987).

This is not so, however, when reliance expenditures are present. Consider the buyer and seller's joint incentives: given the entrant's strategy identified in Lemma 2 and the payoffs defined in Lemma 1, their joint *ex post* payoff is $v - c_S(r)$ for every realization of c_E and for every contract $\langle p_0, p_1 \rangle$. Therefore, from an *ex ante* perspective, the seller and buyer want to write a contract that induces the seller to choose r to maximize $v - c_S(r) - r$, their joint *ex ante* payoff. Define r_J to be the reliance level that maximizes this (concave) expression; r_J satisfies the condition $c_S'(r_J) = -1$. Comparing this expression with equation (2) reveals that $r_J > r^*$; the seller and the buyer have an

[18] This is in the spirit of Bertrand-style competition. If, as in Aghion and Bolton (1987), the entrant did not appear at all when $c_E \geq c_S$ (or, equivalently, p_E approached infinity) then, with somewhat stronger concavity assumptions, the same results would be obtained.

ex ante incentive to overinvest relative to the socially optimal level.

The best reliance level from the buyer and seller's perspective differs from the social optimum for a very simple reason: when the seller invests more, the entrant must lower the price he charges in those states where he is the efficient producer. Because the buyer-seller pair do not internalize the negative effect that the seller's investment level has on the entrant, they have an incentive to induce too high a level of investment. Put somewhat differently, the buyer and seller jointly see a return from the seller's investment not only in states where the seller ends up producing, which is all that the social planner cares about, but also in states where it is the entrant who produces the good.

We next show that the buyer and seller not only have an incentive to induce a socially excessive reliance level, $r_J > r^*$, but also have the ability to do so. The following lemma establishes that any reliance level $r \in [r^*, r_J]$ can be implemented through an appropriately chosen contract, $\langle p_0, p_1 \rangle$. Within this range, higher levels of reliance are implemented through larger stipulated damages, i.e., through smaller values of $p_1 - p_0$.[19]

LEMMA 3: Given a contract $\langle p_0, p_1 \rangle$, define $\tilde{r}$ such that $c_S(\tilde{r}) = p_1 - p_0$. If $\tilde{r} \in [r^*, r_J]$, then the seller's optimal reliance level is precisely $\tilde{r}$. Furthermore, if $\tilde{r} > r_J$ then the seller optimally chooses $r = r_J$, and if $\tilde{r} < r^*$ the seller chooses $r < r^*$.

PROOF:

Case (A): $\tilde{r} \in [r^*, r_J]$.

If the seller chooses a reliance expenditure $r < \tilde{r}$, then $p_E = \max \{c_S(r), c_E\} > p_1 - p_0$ and

[19] It is not difficult to show that in the absence of any contract, the seller will set his reliance level below r^*. In fact, the seller's payoff absent a contract here is exactly the same as in the case of a non-strategic entrant. Hence, the result follows exactly as discussed in Section II.

by Lemma 1 the seller's payoff (exclusive of reliance expenditures) is $p_1 - c_S(r)$ for all realizations of c_E. If $r = \tilde{r}$, then the seller earns $p_1 - c_S(r)$ if $c_E > c_S(\tilde{r}) = p_1 - p_0$, and p_0 if $c_E \leq c_S(\tilde{r}) = p_1 - p_0$. But since $p_0 = p_1 - c_S(\tilde{r})$, the seller earns $p_1 - c_S(\tilde{r})$ in this case for all realizations of c_E. Thus, for those low values of $r \in [0, \tilde{r}]$, the seller's *ex ante* expected payoff given reliance level r is $\pi_L(r) = p_1 - c_S(r) - r$. The function $\pi_L(r)$ is strictly concave and reaches a unique maximum at $r = r_J$. Hence, if $\tilde{r} < r_J$, the seller's most preferred expenditure from the set $[0, \tilde{r}]$ is $\tilde{r}$.

If $r > \tilde{r}$, then $c_S(r) < p_1 - p_0$. If $c_E \leq c_S(r)$, then $p_E = c_S(r)$ and the seller receives p_0. If $c_E \in (c_S(r), p_1 - p_0]$ then $p_E = c_E$ and the seller receives $p_0 + \alpha[c_E - c_S(r)]$. If $c_E > p_1 - p_0$ then $p_E = c_E$ and the seller receives $p_1 - c_S(r)$. Therefore, for $r > \tilde{r}$ the seller's *ex ante* expected payoff is given by the function:

$$\pi_H(r) = F(c_S(r))p_0 + \int_{c_S(r)}^{p_1-p_0} [p_0 + \alpha(c_E - c_S(r))]f(c_E)dc_E + [1 - F(p_1 - p_0)][p_1 - c_S(r)] - r\,. \tag{8}$$

Note that $\pi_H(\tilde{r}) = \pi_L(\tilde{r})$ so the function $\pi_H(r)$ gives the seller's *ex ante* expected payoff at $\tilde{r}$ as well. Differentiating we have:

$$\pi_H'(r) = -c_S'(r)\,[1 - \alpha F(c_S(r)) - (1-\alpha)F(p_1-p_0)] - 1 \tag{9}$$

Since $\pi_H'(r) \leq S'(r)$ for all $r \geq \tilde{r}$, and since $S'(r) < 0$ for all $r > r^*$, the seller's most preferred reliance expenditure from the set $[\tilde{r}, \infty]$ when $\tilde{r} \geq r^*$ is $\tilde{r}$. Together these facts imply that the seller optimally chooses $\tilde{r}$ when $\tilde{r} \in [r^*, r_J]$.

Case (B): $\tilde{r} > r_J$

Since $\tilde{r} > r^*$, the seller's most preferred reliance level from the set $[\tilde{r}, \infty]$ is $\tilde{r}$ as in case (A). Now, however, the seller's most preferred choice from the set $[0, \tilde{r}]$ is r_J. Thus, r_J is the seller's optimal choice.

Case (C): $\tilde{r} < r^*$

Since $\tilde{r} < r_J$, the seller's optimal choice from the set $[0, \tilde{r}]$ is $\tilde{r}$ as in case (A). In addition, since $\pi_H'(r) < S'(r)$ for all $r > \tilde{r}$, the seller's optimal choice from the set $[\tilde{r}, \infty]$ must be strictly less than r^*. Together, this implies that the seller chooses $r \in [\tilde{r}, r^*)$. □

Lemma 3 implies that when the seller and the buyer are free from legal restrictions, they can implement reliance level r_J by setting $p_1 - p_0 \leq c_S(r_J)$. Some intuition for this can be gained by considering the extreme case with $p_1 = p_0$, a "take-or-pay" contract. Because the buyer has agreed to pay the seller the full price whether or not trade occurs, the buyer will never breach the contract absent renegotiation. Given that when breach does end up occurring there is no surplus for the buyer and seller to split (since $p_E = c_S(r)$), the seller's payoff is $p_1 - c_S(r) - r$ for all realizations of c_E. The seller therefore optimally chooses r_J.

Given the buyer and seller's previously discussed desire to implement r_J, we have:[20]

PROPOSITION 2: When the entrant is non-competitive (i.e., makes a take-it-or-leave-it offer), the seller and the buyer write a contract with a stipulated damage provision satisfying $p_1 - p_0 \leq c_S(r_J)$, which induces the seller to choose a reliance level r_J that exceeds the socially optimal level r^*. As a result, entry occurs less frequently than in the first-best.

Proposition 2 suggests that in the case of a non-competitive entrant, legal restrictions on privately stipulated damages may improve social welfare. In fact, Lemma 3 tells us that this is so: by imposing the efficient expectation damage, $p_1 - p_0 = c_S(r^*)$, the seller is induced to choose r^*, the socially efficient reliance level. Thus, we have:

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[20] It is sometimes argued that subcontracting (where the seller purchases from the entrant) provides an alternative mechanism to renegotiation for avoiding inefficient procurement in addition (see, for example, Masten and Snyder (1989)). Proposition 2 is robust to the possibility of subcontracting between the seller and the entrant. By specifying a very large damage provision, the seller can guarantee that the buyer would never breach, and by dealing directly with the entrant the seller receives $p_1 - c_S(r) - r$ for all realizations of c_E. It should be noted, however, that in reality the goods produced by the seller and entrant will often not be perfect substitutes, and thus subcontracting absent renegotiation with the buyer would be impossible.

PROPOSITION 3: When the entrant non-competitive (i.e., makes a take-it-or-leave-it offer), social welfare is increased by a legal rule that sets damages equal to efficient expectation damages; that is, such that $p_1 - p_0 = c_S(r^*)$. This damage rule leads the seller to select the socially optimal reliance level, r^*.

As in Section II, it is immediate that in the absence of renegotiation setting $p_1 - p_0 = c_S(r^*)$ implements the efficient reliance level r^* (see also Chung (1992)). Thus, combining this observation with Proposition 3 and the results of Section II, we see that an efficient damage rule implements the socially efficient outcome for both the cases of a competitive and a non-competitive entrant, and both when renegotiation is possible and when it is not.

It is interesting to note that in the private contracting equilibrium, the stipulated damage equals the seller's actual expectation damages at the equilibrium level of reliance, r_J. Thus, even though this private damage provision exceeds the socially optimal one (the efficient expectation damage), it may not appear excessive *ex post*.

The efficient expectation damage rule differs from the commonly-known damage rules studied in the Law and Economics literature. One difficulty with its implementation, relative to these other more standard rules, is that it depends on the *ex ante* distribution of the entrant's costs, $f(c_E)$, as well as on the function $c_S(r)$. In contrast, the standard measures depend only on *ex post* realizations of costs (or actual reliance expenditures).

We conclude our analysis by studying the effects of three court-imposed damage measures in this setting with a non-competitive entrant and renegotiation: expectation damages, specific performance, and reliance damages.[21]

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[21] We should note, however, that the model's interpretation in this case is potentially problematic. In particular, while the court is assumed to be able to observe the seller's costs (or reliance level) to implement the first and third of these rules, the parties are assumed to be unable

To start, consider the expectations damage measure. For a given p_1 and realization of c_S, the expectations damage measure awards damages for breach that make the seller as well off as he would have been if the transaction had been completed: $p_0 = p_1 - c_S$. Under this damage measure, if the seller chooses r, he earns $p_1 - c_S(r)$ regardless of the realization of c_E, and therefore chooses reliance level r_J. In part, this is a standard result: the expectations damage measure effectively insures that seller against breach and leads to over-investment (Shavell (1980), Rogerson (1984), Chung (1992)). However, in the present context we also see that it leads to the same outcome as if the buyer and seller were free to stipulate damages.

Under specific performance, the court forces the transaction to go through as planned (unless the initial contract is renegotiated): the buyer must pay p_1 to the seller and the seller must provide the good. This is effectively equivalent to requiring that $p_0 = p_1$, since with a take-or-pay contract the buyer will not breach unless renegotiation occurs.[22] Hence, by Lemma 3 the seller once again chooses reliance level r_J.

Finally, under the reliance damage measure, the court returns the seller to the pre-contractual position by having the buyer compensate the seller for his reliance investment.[23] In other words, given r the court sets $p_0 = r$. In the absence of up-front transfers, it is straightforward to verify that if r is the equilibrium investment level induced by a contract that gives the seller a non-negative payoff, then $p_1 - r \geq c_S(r)$. To see this, suppose that $c_S(r) > p_1 - r$. Then if $c_E > c_S(r)$

to contract on them. Perhaps the most natural interpretation is that this arises because of costs involved in describing the desired reliance level in a contract.

[22] Another possible interpretation of specific performance is that $\langle p_0, p_1 \rangle$ is enforced. This is equivalent to private stipulated damages.

[23] This discussion presumes that the equilibrium allocation of the surplus between the buyer and the seller at the initial contracting stage was achieved by choosing appropriate magnitudes of p_1 and p_0. If, instead, an up-front transfer has been made, then the reliance damage measure also involves the return of this payment. Under this alternative interpretation, all of the results that follow continue to hold.

the entrant sets $p_E > c_S(r) > p_1 - r$, the buyer has no incentive to breach, and the seller receives $p_1 - c_S(r) - r < 0$. If $c_E \leq c_S(r)$ the entrant sets $p_E = c_S(r) > p_1 - r$ and renegotiation again gives the seller a payoff of $p_1 - c_S(r) - r < 0$. We conclude that $p_1 - r \geq c_S(r)$. Now consider the seller's payoff (inclusive of reliance) for three cases: (1) if $c_E > p_1 - r$ then the seller gets $p_1 - c_S(r) - r$; (2) if $p_1 - r \geq c_E > c_S(r)$ then the seller gets $\alpha[c_E - c_S(r)]$; (3) if $c_E \leq c_S(r)$ then the seller gets 0. Differentiating the seller's expected payoff with respect to r yields:

$$\pi_S'(r) = -\alpha c_S'(r)\,[F(p_1-r) - F(c_S(r))] + (1-\alpha)f(p_1-r)[p_1-c_S(r)-r] + [1-F(p_1-r)][-c_S'(r)-1]\ . \quad (10)$$

From this expression we conclude that $\pi_S'(r_J) \geq 0$, and $\pi_S'(r_J) > 0$ if $p_1 - c_S(r) - r > 0$, so the seller's investment under the reliance damage measure (weakly) exceeds the joint profit-maximizing level.

In summary, we have:

PROPOSITION 4: When the entrant prices non-competitively, the standard court-imposed damage measures all lead the seller to over-invest relative to the social optimum. Expectation damages and specific performance give the same outcome as private stipulated damages (r_J), while the reliance measure leads to a (weakly) greater level of investment.

IV. CONCLUSION

The forgoing analysis makes three primary points. First, with a competitive entrant, the buyer and seller not only have an incentive to sign a socially efficient contract, but can also achieve the first-best using a relatively simple stipulated damage contract that sets damages equal to the efficient expectation damage. Second, in the presence of relationship-specific investment, the inefficient strategic use of stipulated damages identified by Aghion and Bolton (1987) for the case of a non-competitive entrant emerges despite the buyer and seller's ability to renegotiate. Third, in these latter settings, a legal restriction requiring efficient expectation damages would implement the first-best, while three more standard court-imposed rules (expectation damages, specific performance, and reliance damages) all fail to correct the inefficiency.

It should be emphasized that all of our results are independent of the relative bargaining strengths of the buyer and incumbent seller, either *ex ante* at the contract formation stage, or *ex post* during renegotiation. One might wonder, however, about the effects of relaxing our assumption that the entrant can make a take-it-or-leave-it offer to the buyer, an assumption that gives the entrant all of the bargaining power vis-a-vis the buyer. In the appendix, we study the situation where the entrant's price is set at $p_E = \beta c_E + (1-\beta)c_S$ if $c_E \leq c_S$, and $p_E = c_E$ if $c_E > c_S$. This assumption corresponds to the case where with probability β the buyer gets to make a take-it-or-leave-it offer to the entrant, while with probability $(1-\beta)$ it is the entrant who makes a take-it-or-leave-it offer. When $\beta = 1$ we have a competitive entrant as in Section II (i.e., one with no market power), while when $\beta = 0$ we have the case studied in Section III. We show that with some weak additional regularity conditions, for all $\beta < 1$ the buyer and incumbent seller write a contract stipulating a socially excessive damage payment that implements their jointly optimal reliance level, $r_J > r^*$ (in the limiting case where $\beta = 1$, we get $r_J = r^*$). In addition, as above, efficient expectation damages would result in the first-best outcome for all β. Two differences from the analysis above do emerge, however. First, when $\beta \in (0,1)$ the equivalence between expectation damages, specific performance, and private damage stipulation no longer holds. Letting r_{EXP}, r_{SP}, and r_{REL} denote the reliance levels under expectation damages, specific performance, and reliance damages, we now have that $r^* < r_J < r_{SP} < r_{EXP} \leq r_{REL}$. Thus, in this case, all three of these standard damage measures worsen the inefficiency generated by private contracting (which leads to r_J). Second, the privately stipulated damage used to implement r_J exceeds the expectation measure evaluated at r_J: $p_0 > p_1 - c_S(r_J)$.

Thus, the contract features a penalty clause.

The results also extend to other variations of the simple buyer-seller scenario. For example, consider the case where the entrant is instead another buyer, so that it is the seller rather than the buyer who may have an alternative opportunity, and suppose that it is the buyer rather than the seller who now invests (imagine that the buyer's value from consuming the seller's product is given by $v(r)$, while the seller's cost is the fixed value c_S). It is straightforward to see that this setting is isomorphic to the one considered above, and so all of our results still hold. As another example, suppose that we alter our model so that the party without an investment decision is the one with an alternative opportunity. Thus, let the buyer have valuation $v_S(r)$ for the seller's product, and let the seller's cost be fixed at c_S. In parallel to the analysis above, in the presence of a non-competitive entrant the buyer and seller want to implement the reliance level satisfying $v_S'(r_J) = 1$, which is socially excessive, and they can again accomplish this goal with a take-or-pay contract.

Finally, although the discussion above has interpreted the economic setting in terms of an incumbent seller, a buyer, and an entrant, the model actually has much broader application. For example, consider the case where a regulatory authority who seeks to maximize consumer surplus grants a franchise monopoly to a firm at date t. Sometime in the future, however, an alternative more efficient supplier may appear. In the interim, the incumbent franchisee will invest in cost reduction. The terms of the franchise specify a price that the firm will receive for the good, p_1, and a payment to be made to the firm in the event that the regulator cancels the franchise, p_0. Our analysis shows that if the regulator will not have all of the bargaining power in negotiations with the new supplier, then the optimal initial franchise contract for the regulator involves introducing a "bias" toward the initial franchisee through a large termination fee.

Similarly, the model also has applications to managerial contracts and "golden parachutes." Suppose, for example, that S is the current management team of a firm, B is the firm's owner, and

E is an alternative management team that may appear at a later date. In the interim, the initial management team invests in learning how to efficiently manage the firm (i.e., it lowers its disutility of managing the firm satisfactorily). Then the owner and the original management team will have an incentive to write a socially excessive termination payment -- a golden parachute -- into the initial contract so as to extract rents from the future management team.

APPENDIX

Suppose that for any contract, $\langle p_0, p_1 \rangle$, the entrant's price is $p_E = c_E$ if $c_E > c_S$, and is $p_E = \beta c_E + (1-\beta)c_S$ if $c_E \le c_S$. β captures the entrant's degree of market power; when $\beta = 1$ the entrant prices competitively (as in Section II), and when $\beta = 0$ the entrant has all of the bargaining power (as in Section III).

Since renegotiation between the buyer and the seller will always guarantee procurement from the most efficient source, we can write the buyer and seller's joint *ex ante* payoff, $\pi_J(r)$, as:

$$\pi_J(r) = [1-F(c_S(r))][v-c_S(r)] + \int_0^{c_S(r)} [v-\beta c_E-(1-\beta)c_S(r)]f(c_E)dc_E - r \,. \tag{11}$$

Differentiating this expression tells us that r_J, the reliance level that maximizes this expression, satisfies:[24]

$$\pi_J'(r_J) = -c_S'(r_J)[1-\beta F(c_S(r_J)] -1 = 0 \,. \tag{12}$$

As β rises (the entrant becomes more competitive) r_J falls; when $\beta = 1$, then r_J is simply r^*, the social optimum.

We now analyze the seller's expected payoff as a function of r, given a contract $\langle p_0, p_1 \rangle$. Defining $\tilde{r}$ to satisfy $c_S(\tilde{r}) = p_1 - p_0$ (as before) and $\hat{r}$ to satisfy $c_S(\hat{r}) = (p_1-p_0)/(1-\beta)$, we can represent the seller's payoff in three pieces.

<u>Case 1</u>: $r \ge \tilde{r}$. $\quad (c_S(r) \le p_1 - p_0.)$

When $c_E \le c_S(r)$, the buyer breaches without renegotiation giving the seller p_0. When $c_S(r) < c_E \le p_1 - p_0$ the entrant sets $p_E = c_E$ and renegotiation is necessary for efficient procurement; the

[24] It is easy to show that concavity of the social welfare function, S(r), is a sufficient condition for $\pi_J(r)$ to be concave.

seller's payoff is $p_0 + \alpha(c_E - c_S(r))$. When $c_E > p_1 - p_0$, the seller supplies the good and receives $p_1 - c_S(r)$. Therefore the seller's expected payoff is:

$$\pi_H(r) = F(c_S(r))p_0 + \int_{c_S(r)}^{p_1-p_0}[p_0+\alpha(c_E-c_S(r))]f(c_E)dc_E + [1-F(p_1-p_0)][p_1-c_S(r)] - r . \tag{13}$$

The derivative of this expression is:

$$\pi_H'(r) = -c_S'(r)\,[\,1 - (1-\alpha)F(p_1-p_0) - \alpha F(c_S(r))\,] - 1 . \tag{14}$$

Case 2: $\hat{r} < r < \tilde{r}$. $(p_1-p_0 < c_S(r) < (p_1-p_0)/(1-\beta).)$

If $c_E < c_S(r)$, the buyer will breach absent renegotiation if and only if $\beta c_E + (1-\beta)c_S(r) \leq p_1 - p_0$, or $c_E \leq (p_1-p_0)/\beta - c_S(r)(1-\beta)/\beta$. Let the value of the right hand side be denoted $c^*(r)$; it is easy to show that (for case 2) $0 < c^*(r) < p_1 - p_0$.

When $c_E \leq c^*(r)$, the buyer breaches absent renegotiation and no renegotiation occurs, giving the seller p_0. When $c^*(r) < c_E \leq c_S(r)$, renegotiation leads to efficient procurement and the seller's payoff is $p_1 - (1-\alpha\beta)c_S(r) - \alpha\beta c_E$. Finally, when $c_E > c_S(r)$ the buyer does not breach and the seller receives $p_1 - c_S(r)$. The seller's expected payoff is:

$$\pi_L(r) = F(c^*(r))p_0 + \int_{c^*(r)}^{c_S(r)}[p_1-(1-\alpha\beta)c_S(r)-\alpha\beta c_E]f(c_E)dc_E + [1-F(c_S(r))](p_1-c_S(r)) - r. \tag{15}$$

Differentiating,

$$\pi_L'(r) = -c_S'(r)\{1-\alpha\beta F(c_S(r)) - (1-\alpha\beta)F(c^*(r)) + \frac{(1-\beta)(1-\alpha)}{\beta}f(c^*(r))(c_S(r)-(p_1-p_0))\} - 1. \tag{16}$$

Case 3: $r \leq \hat{r}$. $(c_S(r) \geq (p_1-p_0)/(1-\beta).)$

It is easy to show that $c^*(r)$ (defined in case 2) is now non-positive. Therefore for all realizations of $c_E \leq c_S(r)$ the buyer will not breach absent renegotiation, and renegotiation gives the seller $p_1 - (1-\alpha\beta)c_S(r) - \alpha\beta c_E$. When $c_E > c_S(r)$, $p_E = c_E$, and the buyer does not breach (since

$c_E > c_S(r) > p_1 - p_0$) and the seller receives $p_1 - c_S(r)$. Therefore we have

$$\pi_{LL}(r) = \int_0^{c_S(r)} [p_1 - (1-\alpha\beta)c_S(r) - \alpha\beta c_E] f(c_E) dc_E + [1 - F(c_S(r))][p_1 - c_S(r)] - r \,, \tag{17}$$

and

$$\pi'_{LL}(r) = -c'_S(r)[1 - \alpha\beta F(c_S(r))] - 1 \,. \tag{18}$$

Note that $\pi_H(\tilde{r}) = \pi_L(\tilde{r})$ and $\pi_L(\hat{r}) = \pi_{LL}(\hat{r})$. Moreover, $\pi_H'(\tilde{r}) = \pi_L'(\tilde{r})$ and $\pi_L'(\hat{r}) \geq \pi_{LL}'(\hat{r})$.

If we choose $\langle p_0, p_1\rangle$ such that $p_1 - p_0 = c_S(r_J)$ so that $\tilde{r} = r_J > r^*$, then the seller chooses $r < r_J$ (since then $\pi_H'(r) \leq S'(r) < 0$ at all $r \geq \tilde{r} = r_J$, and $\pi_H'(\tilde{r}) = \pi_L'(\tilde{r})$). If we set $p_1 - p_0 = (1-\beta)c_S(r_J)$ so that $\hat{r} = r_J > r^*$, then the seller chooses $r \geq r_J$ (since $\pi_L'(\hat{r}) \geq \pi_{LL}'(\hat{r}) \geq \pi_J'(\hat{r}) \geq 0$). Moreover, for any $\langle p_0, p_1\rangle$ such that $p_1 - p_0 \in [(1-\beta)c_S(r_J), c_S(r_J)]$, the seller's optimal reliance level lies in the set $[\hat{r}, \tilde{r}]$, a range corresponding to the function $\pi_L(r)$. Therefore if $\pi_L(r)$ is continuous in $p_1 - p_0$ then the buyer and the seller can implement r_J with some contract with some $p_1 - p_0$ in this interval.[25] Note that, in contrast to the analysis in Section III, the stipulated damages at this solution exceed the expectations damages evaluated at r_J (as well as exceeding the socially optimal damages).

Note also that by restricting $p_1 - p_0 = c_S(r^*)$ the court can induce the seller to choose r^*, as in the text. When $r^* = \tilde{r}$, for $r < \tilde{r}$ the private marginal incentive to invest exceeds the social incentive, and when $r > \tilde{r}$ the private incentive is smaller than the marginal social incentive.

We can also rank the three standard court-imposed damage measures for breach of contract. Define r^+ as $c_S'(r^+) = -1$; note that when $\beta = 0$, $r_J = r^+$. Letting r_{SP}, r_{EXP}, and r_{REL} denote the

[25] A sufficient condition for $\pi_L(r)$ to be continuous in p_1-p_0 is that it is strictly concave in r. It can be shown that weak sufficient conditions for strict concavity are $S''(r) < 0$ (social welfare is concave) and $f'(c_E) \geq 0$.

reliance values under specific performance, expectations damages, and reliance damages, respectively, we can establish the following ranking: $r^* < r_J < r_{SP} < r_{EXP} = r^+ \leq r_{REL}$.

Recall that under the expectations measure, $p_0 = p_1 - c_S(r)$. Since the buyer's breach decision is always efficient under this measure renegotiation never occurs. Consequently the seller receives $p_1 - c_S(r) - r$ for all realizations of c_E. Hence, $r_{EXP} = r^+$.

Under specific performance, $p_0 = p_1$ so the buyer will never breach absent renegotiation. When $c_E > c_S(r)$ no renegotiation occurs and the seller gets $p_1 - c_S(r) - r$; when $c_E \leq c_S(r)$ the contract is renegotiated and the seller receives $p_1 - c_S(r) - r + \alpha\beta(c_S(r) - c_E)$. It is straightforward to verify that $r_{SP} < r^+$ and that $r_{SP} > r_J$.

For the reliance damage measure, one can show that it must be the case that $p_1 - r \geq c_S(r)$; if not, then the seller would surely make negative profits (see the discussion and analysis in the main text). Furthermore, the seller's payoff is precisely the same as in the text. Therefore we conclude that $r_{REL} \geq r^+$, with strict inequality if $p_1 - r_{REL} > c_S(r_{REL})$.

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