Incomplete Contracts with Asymmetric Information: The Option to Enforce

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1. Introduction

Specific performance has been conventionally considered the exceptional remedy for breach of contract, whereas money-damages have been considered the normal remedy.[1] Indeed, the adequacy doctrine, which states that courts will not order specific performance if damages would be adequate to protect the expectation interest of the injured party (Restatement (Second) of Contracts §359 (1979)) has become "the linchpin of the rules governing specific performance in American law."[2]

Moreover, even when contracting parties explicitly provide that their obligations should be specifically enforced, they usually run into difficulties in cases of breach.[3] The majority of courts have stated that a contract with a provision mandating specific performance will not necessarily bind a court to grant the agreed remedy,[4] because the judge maintains discretion to deny specific performance even when parties have explicitly provided for this particular remedy in their contract.[5]

Yet, in recent years scholars have noted two trends. First, courts have expanded their interpretation of situations where damages do *not* constitute an adequate remedy, thus becoming more liberal in awarding specific performance.[6] Second, even if the inclusion of a specific performance clause in a contract may not be binding, it can still play an important role in influencing the court to grant specific performance.[7] There is

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[1] Marvin Chirelstein, *Concepts and Case Analysis in the Law of Contracts*, 163 (2001).

[2] Edward Yorio, *Contract Enforcement, Specific Performance and Injunctions,* 27 (1989).

[3] *Id.* at 247; Yorio, *supra* note 2, at 453 (Although courts seem to have less objection to upholding contractual restrictions on specific relief. *Id.* at 454).

[4] *Id.* (citing *Stokes v. Moore,* 262 Ala. 59, 65 (1955)); Steve Thel, *2003 Cumulative Supplement Contract Enforcement, Edward Yorio,* 192 (2003) (citing *Kakaes v. George Washington University,* 790 A.2d 581, 584 (D.C. Ct. App. 2002)).

[5] *Kakaes,* 790 A.2d at 584. And see the Restatement which sets forth that parties may not vary by an agreement the requirement that damages be inadequate as a precursor to achieving equitable relief. Yorio, *supra* note 2, at 441 (citing Restatement (Second) of Contracts § 359, comment *a* (1979)); Dan Dobbs, *Law of Remedies,* Vol. 3, 270 (1993).

[6] Chirelstein, *supra* note 1, at 163; Dobbs, *supra* note 5 at 197. Others have even argued that the adequacy test is dead and has little to no effect on the courts' decisions. *Id.*; Douglas Laycock, *The Death of the Irreparable Injury Rule* (1991).

[7] Yorio, *supra* note 2, at 447; Thel *supra* note 4, at 197 (citing *Finance Auth. v. L.L. Knickerbocker Co.,* 106 F. Supp. 2d 44, 52 (D. Me. 1999); *Stumpf v. Richardson,* 748 So. 2d 1225, 1227 (La. Ct. App. 1999); *Ludington v. LaFreniere,* 704 A.2d 875 (Me. 1997)) ; Dobbs, *supra* note 5, at 271 (citing *Stokes,* 262 Ala. 59 (1955); *Presto-X-Co. v. Ewing,* 442 N.W.2d 85, 89 (Iowa 1989)). For example, a court may uphold a clause for specific performance when the cost of enforcing the equitable relief is low or the court doubts the adequacy of other remedies. Yorio, *supra* note 2, at 447-48. In a close case, a court may be influenced by a

even a minority approach that provides *some* authority that clauses for specific performance may bind the court, regardless of whether the remedy is otherwise appropriate.[8]

Commercial contacts are not much different in this respect. The old section 2-716 of the UCC (Buyer's right to specific performance or replevin) stated that specific performance may be decreed only "where the goods are unique or in other proper circumstances." This may change soon though, as in May 2003 the ALI approved amendments to section 2-716.[9] It is expected that enactment of these provisions in state legislatures will be sought.[10] One of the major changes to section 2-716 expands the remedies that the Buyer is entitled to. Specifically, the new section 2-716 reads that in non-consumer contracts,[11] "specific performance may be decreed if the parties have agreed to that remedy."[12] The preliminary official comments state that "the parties' agreement for specific performance can be enforced even if legal remedies (i.e. damages) are entirely adequate."[13]

The ALI has approved another change to the UCC which is relevant to this paper. The new section 2-718 (liquidation or limitation of damages; deposits) eliminated the requirements for non-consumer contracts requiring a party seeking to enforce a liquidated damages term to demonstrate the difficulty of proving the loss and the inconvenience or nonfeasibility of obtaining an adequate remedy, thus giving more weight to parties' ex-ante stipulated damages, vis-à-vis other court-imposed ex-post damages.[14]

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contract between parties that states that that the product or service is unique or that money damages are inadequate. *Id.* at 448. Thel, *supra* note 4, at 198 (citing *Peuse v. Malkuch,* 911 P.2d 1153 (Mont. 1996)).

[8] Thel, *supra* note 4, at 198 (citing *Media General Broadcasting v. Pappas Telecasting,* 152 F.Supp. 2d 865, 869 (W.D. N.C. 2001) (stating that despite the sufficiency of money damages, the parties may choose their remedies in line with their particular needs)).

[9] The title of 2-716 has been changed to "Specific performance; Buyer's right to replevin".

[10] These amendments were previously approved by the NCCUSL on August 2002, so the NCCUSL can seek enactment in state legislatures. The National Conference of Commissioners on Uniform States Laws (NCCUSL) and the American Law Institute (ALI) are jointly responsible for drafting, updating and promulgating the Uniform Commercial Code (UCC).

[11] For consumer contracts the major remedy remained damages.

[12] Cite.

[13] Cite.

[14] Preliminary official comments, section 2. Another related change is the elimination of the part in section 2-718 which stated that unreasonably large liquidated damages are void as penalty. As a result the only relevant criterion is whether the liquidated damages are reasonable in light of the anticipated or actual harm caused by the breach. As the preliminary comment explains, "a liquidated damages term that provided for damages that unreasonably small is likewise unenforceable". Preliminary official comments, section 3.

These two changes—that the parties' stipulated damages clause and their agreement for specific performance will be enforced by courts—have been advocated for years by legal economists.[15] But if parties' specific performance and stipulated damages clauses will indeed increasingly be enforced by courts, then one may reasonably anticipate that the parties' agreement to give the promisee, upon breach, the *option* to choose between these remedies will increasingly also be enforced by courts. Indeed if these remedies are enforced when parties write them into the contract at the time of entering the contractual relationship, why wouldn't they be enforced if parties explicitly agreed to let the promisee decide at a later time (upon breach) which of these remedies to receive? Thus, for example, we estimate that a contract which allows the promisee to decide unilaterally and *upon breach* whether to enforce the stipulated damages clause or receive instead specific performance may increasingly be enforced. If we are right in our estimation, then the doctrinal changes mentioned above may allow for more room for contract design than previously thought. If we are wrong, then this paper should be read as making a normative, and not a positive, claim.

In this paper we present a model which takes advantage of the two important changes mentioned above. In our model the court is required to honor parties' ex-ante stipulation that the choice of remedy will be determined by the Buyer upon breach. Specifically, our new proposed rule allows the parties to stipulate ex-ante that the Buyer will choose whether she wants specific performance or pre-determined liquidated damages. Yet, the Buyer will make her choice ex-post upon the breach of the contract and not ex-ante at the date when parties enter the contract,

We focus on the ex-ante design of the contract in light of new information that is expected to arrive and therefore assume that no renegotiation or investments are involved.[16] We propose contract clauses which take advantage of information that the Seller and the Buyer receive between the time they entered the contract and the time of the actual breach.

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[15] Tom Ulen, *The Efficiency of Specific Performance: Toward a Unified Theory of Contract Remedies,* 83 MICH L. REV. 341; Charles Goetz & Robert Scott, Liquidated Damages, *Penalties and the Just Compensation Principle: Some Notes on an Enforcement Model and Theory of Efficient Breach,* 77 COLUM L. REV. 554

[16] Indeed, in an environment of asymmetric information renegotiation costs are high.

We further suggest that courts would, or at least should, honor such clauses. We argue that the developments in the law identified above allow us to estimate that the proposed clauses may be employed by parties and honored by courts.

In section two we present a simple model with two-sided incomplete information with liquidated damages clause. In section three we compare the performance of these new proposed legal regime with current legal regimes and then determine the conditions at which the new regimes should be applied.

The appendix provides a more rigorous mathematical treatment of our model.

2. Related Literature

In this section we survey previous related work and distinguish our work. Current literature indicates that complex contracts that apply a mechanism design approach can achieve first best when the parties' valuations are observable, and sometimes even when they are not. Moreover, simple contracts may achieve first best as well, but only if parties' valuations are observable and costless renegotiation is possible. In contrast, we explore a simple contract where the parties' valuations are assumed to be *un*observable, which means that renegotiation at this stage is costly; indeed we assume that it is prohibitively costly. We now describe the literature in more detail.

Most of the literature applies a "mechanism design" approach to optimal contracting, and articles written within this approach attempt to find ways to provide parties with incentives to truthfully reveal their valuation. Myerson & Satterthwaite (1983) famously showed in a mechanism design paper with *a*symmetric information that first-best is impossible to achieve. (See also Diamond & Maskin (1979) and Stole (1992)). Because the parties own private information prior to contracting, the terms proposed reveal their private information to the other party. This signaling can lead to distortions in the contract which undermine the efficiency. To overcome the impossibility of Myerson & Satterthwaite (1983), scholars have studied mechanisms that are formed at the ex-ante stage, before parties learned their own valuations, when they are symmetrically (un)informed. D'Aspremont & Gerard-Varet (1979), Riordan (1984), Konakayama, Mitsui & Watanabe (1986), Hart & Moore (1988), Chung (1991),

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Rogerson (1992), Che & Hausch (1999) and Watson (2003) are all such articles. In general, depending on the particular information structure they applied, first-best was shown to be achievable.

Yet, most of these articles focus on situations where parties' valuations or investment decisions, once realized, were symmetrically observable by the other parties, even if unverifiable to courts. In such environment, Hart & Moore (1988) famously argued that ex-post renegotiation, and the hold-up problem it entails, will lead to under-investment. Other work which relaxes different assumptions in Hart & Moore work has been able to restore first-best (see for example Noldeke & Schmidt (1995) which assigned courts with greater "verifiability" powers).

Our work is different in two respects. First, while our focus in the article is also on the ex-ante contract design, our work goes beyond these papers in that we assume (like Mayerson & Satterthwaite (1983)) that a party's valuation after she has learned it, is *not* observable to the other party. Instead, parties at the ex-ante stage anticipate that at the trade-or-breach stage, they will face asymmetric information and therefore consider the other's valuation as a random variable.

The second difference in our work is that it is a "contract design" paper and not a "mechanism design" paper. Mechanism-design contracts have been criticized for faring poorly with respect to simplicity of their design, ease of their enforcement and robustness to renegotiation (Tirole, 1986, Rogerson 1992, Harmelin & Katz, 1993). They are also susceptible to courts' errors (Zhang & Zhu 2000). We, therefore, restrict our attention to non-contingent contracts, which are more commonly used in practice and are easier to enforce.

Hermalin & Katz (1993) considered a simpler form of the mechanism-design contracts that Konakayam, Mitsui & Watanabe (1986), Riordan (1984), and Rogerson, (1984) considered in the past. Specifically, they considered a fill-in-the-price mechanism in which the parties set up a price schedule at the ex-ante stage (when they are symmetrically *un*informed of their valuations). After parties made their investment decisions, they each learn about their own valuations. Then, one party (the Seller in their example) announces a price, and the other party (the Buyer) decides whether to purchase and make a payment according to the price schedule agreed in the ex-ante stage.

Hermalin and Katz showed that this fill-in-the-price contract can achieve first-best under some information structures (parties' valuations at the second stage is either perfectly observable, or totally unobservable by at least one party). Yet, when parties' valuations are imperfectly observable the contract cannot achieve first-best. Unlike Hermalin and Katz we explore cases where parties' distributions are not independent.

Noldeke and Schmidt (1995) attempted to solve the Hart & Moore (1988) underinvestment problem by designing a simple option contract, which gives the Seller the right not to deliver and specifies the payment depending on whether delivery (which is assumed to be verifiable) took place. But Noldeke & Schmidt assume that parties' valuations are perfectly observable, and this assumption is crucial to their model, which achieves first-best through efficient renegotiation. We, in contrast, assume that informational asymmetry remains even at the exchange date and therefore consider renegotiation to be prohibitively costly.

Within the non-contingent contract-design branch of literature, one can find fixed-price contracts, with or without damage clauses. Shavell (1980, 1984), Rogerson (1984), Aghion & Bolton (1989), Chung (1992), Spier & Whinston (1995), Edlin and Reichestein (1996), Miceli (1997), Zhu (2000), Zhang & Zhu (2000) are all such articles. These papers usually deal with one-sided uncertainty with or without accounting for possible renegotiation between the Buyer and the Seller. (In some cases, the uncertainty comes from a third-party's offer. Chung (1991) studies such a case and assumes no-renegotiation). Schmitz (2001) is an excellent survey.

More relevant to our focus on non-contingent contracts, some of these articles following Shavell (1980, 1984) and Rogerson (1984) compared several commonly used damage measures and the incentives they provide for parties to breach and rely. These papers too usually focus on an environment of one-sided uncertainty, which is observable to the other party, with or without renegotiation. Edlin (1998) and Edlin & Schwartz (2003) are excellent surveys.

Edlin & Reichelstein (1996) studied non-contingent contracts and showed that when only one side needs to make self-investments, both the expectation damages and the specific performance remedies achieve first-best. When both parties' investment decisions were considered, Edlin & Reichelstein were able to derive the conditions under

which specific performance (but not expectation damages) can provide parties with adequate incentives to invest. Edlin & Reichelstein assumed (like Rogerson (1984)) that renegotiation was costless and that parties can observe each other's valuation and, contra Rogerson (1984), that the traded good is divisible.

But, as in the mechanism design branch of literature discussed above, the information structure matters. Like Shavell (1980), our paper assumes that renegotiation is prohibitively costly and that the traded good is indivisible. Unlike Shavel (1980) though our work deals with two-sided uncertainty and, unlike Edlin & Reichelstein (1996), we assume asymmetry of information even at the trade date.

Closer to our information structure is Stole (1992), who analyzed contracts with asymmetric information and without accounting for investments and renegotiation. In his setting the Seller's costs were common knowledge. Yet, the informational asymmetry arose from two sources. First, the Buyer's valuation, which was her private information. Second, from a third-party's (a Buyer's) offer to the Seller, which was the Seller's private information. Stole demonstrated that the optimal liquidated damages are always below full expectation damages, thus justifying the penalty doctrine in such an environment. Stole studied an interim contract (where parties have private information prior to contracting). While replicating Stole's result in our setting, we go beyond that in two ways. First, in our model parties contract before they learn their private information; although they anticipate to learn it by the time the Seller would have to decide whether or not to deliver. Second, we propose a new type of simple remedy which can enhance efficiency in trade under such circumstances.

In the last part of this paper (Future Research) we offer ways to extend the analysis of the paper. Among other things we talk about investment decisions and renegotiation. A quick note on the renegotiation assumption is nevertheless necessary here. First, most papers that used non-contingent contracts needed the assumption of costless renegotiation to achieve first-best. Yet, a renegotiation game is never costless ex-post and hard to design ex-ante. It is thus questionable whether writing a non-contingent contract and designing a renegotiation game (which itself should be renegotiation proof) is indeed simpler than writing a contingent contract (Schmitz (2001)).

Second, and more importantly, one should bear in mind that our information structure is less restrictive than many other papers because the decision whether to deliver or breach is made under asymmetric information, meaning parties' valuations are *not* observable. Indeed, renegotiation under such condition is by no means a costless process. Models which account for renegotiation typically assume that parties' valuations at the trade-or-renegotiate stage are observable. (Hart & Moore (1988), Chung (1991), Noldeke & Schmidt (1995), Spier & Whinston 1995, Edlin & Reichelstein (1996)).

Third, some argue that parties may find ways to prevent renegotiation, or at least find ways to raise its costs significantly. Maskin and Tirole (1999) analyze several ways parties can commit to not renegotiate. Hart & Moore (1999) provide interesting responses. Fourth, even if renegotiation is simple, this paper provides a bench mark for assessing the change due to renegotiation (see Rogerson (1992)). Lastly, as Hart & Moore (1999) recently noted, both cases where parties can and cannot commit to not renegotiate- are worthy of study. As Hart and Moore argue, the degree of the parties' ability to committing not to renegotiate "is something about which reasonable people can disagree."

3. The model- with liquidated damages

3.1 The setting.

At Time 1 a Seller-supplier and a Buyer-manufacturer (both are risk-neutral) enter a contract for the sale of a single unit of indivisible goods that the Buyer-manufacturer needs for its production of the finished goods. The Seller receives the money upon performance, that is, when he supplies the good sometime in the future, call it Time 2. Among other things, the parties agree on a price and liquidated damages to be paid in case the Seller does not deliver in Time 2. There is uncertainty about Seller's cost of production due to future fluctuations in the market prices for the inputs for the materials the Seller promised to deliver. Thus it is assumed that Seller's costs, c, is drawn from a density function $f(c)$ with cumulative density function denoted $F(c)$ in the interval $[\underline{c}, \overline{c}]$. There is also uncertainty about Buyer's valuation of the contract due to future fluctuations in the market prices of the products the Buyer ultimately manufactures and sells. Thus, it is assumed that Buyer's valuation, v, is drawn from a density function $g(v)$ with cumulative density function denoted $G(v)$ in the interval $[\underline{v}, \overline{v}]$, where $G(.)$ and $F(.)$ are independent. This two-side uncertainty at Time 1 is what makes the determination of liquidated damages difficult. What is clear, however, is that by the time the parties' dispute will be deliberated in courts, call it Time 3, both parties will have learned the new market prices. The Seller will know his costs and the Buyer's her valuation. The following chart presents the timeline.

Chart 1- Time line for the model with liquidated damages.

1		2	3
Parties enter a contract	Parties learn new information	Seller delivers or not	Court decides and parties obey

At Time 1, the Seller and the Buyer are symmetrically uninformed about each other's as well as their own valuation. They enter a contract with a price, p, and liquidated damages clause, d. For simplicity we assume that the Buyer has the entire bargaining power so the Seller's surplus from the contract is assumed to be zero. This entails that the Buyer can dictate both the price, p, and the amount of the liquidated damages, d.

We note that the price and liquidated damages written in the contract are correlated and reflect the legal regime employed by the courts that the parties are expected to face at Time 3, if the Seller does not deliver at Time 2. Importantly, we allow the parties to decide in Time 1 about the mechanism by which the liquidated damages will be paid upon breach. This will be called either a *Regular Legal Regime* (RLR) or an *Option to Enforce Regime* (OER). More on this below.

In the interim period between Time 1 and Time 2, both parties learn their true valuation but cannot make any changes to the contract between them (no renegotiation after Time 1). Possible justifications for the parties learning more about their true valuation only after Time 1 is that new information that was unknown before (but which was anticipated to be known later) is now revealed. For example, the Seller learned his exact cost of performance after OPEC withdrew its threat to raise oil prices, or, the Buyer learned that the product she intends to manufacture was approved by some federal agency for distribution in the US, and so forth.

At Time 2 the Seller, after learning his exact cost of performance, decides whether to deliver the good. In making his decision the Seller takes into account the price and liquidated damages agreed upon in Time 1 and the legal regime parties are expected to face at Time 3, if the Seller does not deliver. The Buyer's valuation is not observable to the Seller (or verifiable to third parties). Instead, the Seller continues to consider the Buyer's valuation as a random variable.

At Time 3 the court does *not* hear evidence about the damages that the breach of the promise to deliver caused but rather *always* enforces the agreement between the parties, including the legal regime parties agreed on. Specifically, at Time 3, there are two possible regimes that the court can apply. First, a RLR, in which if the Seller decides to breach he pays damages that are equal to the liquidated damages, d_R. We call it

Regular Legal Regime, because this is the legal regime the literature considers for liquidated damages. Second, an OER legal regime, in which the Buyer can insist on getting specific performance over receiving damages that are equal to d_O. If the Buyer chooses specific performance, the Seller must deliver. If the Buyer chooses to get the liquidated damages, the Seller can then pay the liquidated damages. Simply put, under an OER the Buyer chooses, upon breach, whether to get specific performance or the liquidated damages. At Time 3, when the Buyer makes her decisions, the Seller's realized cost of performance is not observable to the Buyer or verifiable to the court.[17]

We now compare the incentives to breach and parties' expected payoffs under RLR versus under OER.

3.2 Analysis

3.2.1 Regular Liability Regime.

When the legal regime is RLR, (that is when the Seller can choose in Time 3 whether to deliver or breach and pay the liquidated damages), the Buyer offers the Seller in Time 1 a take-it-or-leave-it contract (p_R, d_R), where p_R is the price under RLR and d_R is the liquidated damages under RLR. Price is payable upon performance. The Seller will get $p_R - c$ if she performs, and $(-d_R)$ if she breaches. Therefore, she will breach if $c > p_R + d_R$. If the contract is accepted by the Seller, the Buyer will get an expected payoff which is equal to:

$$p_R^B = F(p_R + d_R)[E(v) - p_R] + [1 - F(p_R + d_R)]d_R \qquad (1)$$

The first term on the right-hand-side represents the Buyer's expected payoff when the Seller decides to perform, and the second term represents the expected payoff when the Seller decides to breach.

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[17] This is a major difference between our model and the models considered in the literature on incomplete contracts. Like other models in the literature we assume that parties in Time 1 only observe each other's distributions. In addition to that we also assume that parties do not know their own valuation, but rather have only an estimate of it. Parties in this sense are symmetrically uninformed: they both observe nothing but their own and each other's distributions. No private information exists. In Time 2 asymmetry of information is introduced. Parties learned their own valuation but still cannot observe (and definitely not verify) their opponent's valuation, but only its initial distribution.

The Seller's expected payoff (if she accepts the contract) is:

$$\boldsymbol{p}_R^S = F(p_R + d_R)[p_R - E(c/c \le p_R + d_R)] + [1 - F(p_R + d_R)](-d_R),$$

The first term represents the Seller's expected payoff if he performs, and the second term represents his expected payoff if he breaches. The Seller's expected payoff can be reduced to:

$$\boldsymbol{p}_R^S = F(p_R + d_R)(p_R + d_R) - \int_{\underline{c}}^{p_R + d_R} c \, dF(c) - d_R. \qquad (2)$$

The Seller's "participation constraint" (or "individual rationality" constraint) requires the Buyer to offer a contract (p_R, d_R) that will maximize Buyer's payoff while ensuring the Seller's payoff being non-negative:

$$\text{Max } \boldsymbol{p}_R^B(p_R, d_R) \text{ s.t. } \boldsymbol{p}_R^S \ge 0.$$

By assumption, the Buyer has the entire bargaining power and therefore can extract the entire ex-ante surplus, which entails that the participation constraint is binding. Note however that *ex-post* the Seller might get some positive payoff (informational rent) because he possesses private information about his- by then realized- production cost.

With some machinery we derive Lemma 1:

Lemma 1

Under RLR with Liquidated Damages, the equilibrium is:

$$d_R^* = \boldsymbol{p}_R^{B^*} = \int_{\underline{c}}^{E(v)} F(c)dc,$$

$$p_R^* = E(v) - d_R^* = E(v) - \int_{\underline{c}}^{E(v)} F(c)dc,$$

$$\boldsymbol{p}_R^{S^*} = 0.$$

Comments:

(a) Proof in the appendix.

(b) It is a standard result in contract theory that expectation damages (under RLR) induce optimal level of breach. But these models generally assume one-sided uncertainty, eg. Miceli (1997, p 73).

(c) Observe that $d_R = E(v) - p_R$ means that the liquidated damages that the Buyer offers equal the *expected* expectation damages. Thus, although from the *ex-ante* perspective the liquidated damages induce optimal level of breach; this does not guarantee an optimal level of breach from the *ex-post* perspective. Specifically, in this case the Seller breaches whenever $c \geq E(v)$. This is inefficient in cases in which $v > c > E(v)$, where v and c represent the ex-post Buyer's valuation and Seller's costs, respectively. Conversely, the Seller will deliver whenever $c < E(v)$, and this is inefficient in cases in which $v < c < E(v)$.

3.2.2 Option to Enforce Regime.

When the legal regime is OER, (that is when the Buyer can insist, upon breach, on specific performance), the Buyer offers the Seller in Time 1 a take-it-or-leave-it contract (p_O, d_O), where p_O is the price under OER and d_O is the liquidated damages under OER. Price is payable upon performance. If the Buyer insists on delivery, she gets $v - p_O$, if she agrees to breach, she gets d_O. Therefore, the Buyer will insist on delivery if $v \geq p_O + d_O$, and will agree to the breach otherwise. The Seller will get $p_O - c$ if he performs, $-d_O$ if she breaches. Therefore, he will attempt to breach if $c > p_O + d_O$.

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If the contract is accepted by the Seller, the Buyer will get expected payoff which is equal to:

$$\boldsymbol{p}_O^B = F(p_O + d_O)[E(v) - p_O]$$
$$+ [1 - F(p_O + d_O)]\{G(p_O + d_O)d_O + [1 - G(p_O + d_O)][E(v/v \geq p_O + d_O) - p_O]\}$$

The first term on the right-hand-side represent s the Buyer's payoff if the Seller performs. The second term represents the payoff if the Seller attempts to breach. The first term in the curly parentheses is the payoff when the Buyer agrees to the breach, and the second term is the payoff when she insists on specific performance. Buyer's payoff can be reduced to:

$$\boldsymbol{p}_O^B = F(p_O + d_O)E(v) - [1 - G(p_O + d_O) + F(p_O + d_O)G(p_O + d_O)]p_O$$
$$+ [1 - F(p_O + d_O)]\left\{G(p_O + d_O)d_O + \int_{p_O + d_O}^{\bar{v}} v dG(v)\right\},$$

The Seller's expected payoff (if she accepts the contract) is:

$$\boldsymbol{p}_O^S = F(p_O + d_O)[p_O - E(c/c \leq p_O + d_O)]$$
$$+ [1 - F(p_O + d_O)]\{G(p_O + d_O)(-d_O) + [1 - G(p_O + d_O)][p_O - E(c/c \geq p_O + d_O)]\},$$

The first term on the right-hand-side represents the Seller's payoff when he chooses to perform. The second term represents his payoff when he attempts to breach the contract. The first term in the curly parentheses is the payoff when the Buyer agrees to the breach, and the second term is the payoff when the Buyer insists on specific performance. Seller's payoff can be reduced to:

$$\boldsymbol{p}_O^S = [1 - G(p_O + d_O) + F(p_O + d_O)G(p_O + d_O)]p_O$$

$$- [1 - F(p_O + d_O)]G(p_O + d_O)d_O - E(c) + G(p_O + d_O)\int_{p_O + d_O}^{\bar{c}} c dF(c)$$

As before, Seller's "participation constraint" requires the Buyer to offer a contract (p_O, d_O) that will maximize Buyer's payoff while ensuring the Seller's payoff being non-negative:

$$\text{Max } \boldsymbol{p}_O^B(p_O, d_O) \text{ s.t. } \boldsymbol{p}_O^S \geq 0$$

The first order condition is:

$$[\int_{\underline{v}}^{p_O+d_O} v dG(v) - (p_O + d_O)G(p_O + d_O)]f(p_O + d_O)$$

$$+ \left\{ \int_{p_O+d_O}^{\bar{c}} c dF(c) - (p_O + d_O)[1 - F(p_O + d_O)] \right\} g(p_O + d_O) = 0,$$

With some machinery we derive Lemma 2 and Lemma 3:

Lemma 2 In equilibrium:

$$\boldsymbol{p}_O^{B^*} = F(p_O^* + d_O^*)E(v) - E(c) + G(p_O^* + d_O^*) \int_{p_O^* + d_O^*}^{\bar{c}} c dF(c) + [1 - F(p_O^* + d_O^*)] \int_{p_O^* + d_O^*}^{\bar{v}} v dG(v),$$

where $p_O^* + d_O^*$ is the solution to

$$p_O^* + d_O^* = \frac{h(p_O^* + d_O^*)}{h(p_O^* + d_O^*) + \boldsymbol{k}(p_O^* + d_O^*)} E(v / v \leq p_O^* + d_O^*)$$

$$+ \frac{\boldsymbol{k}(p_O^* + d_O^*)}{h(p_O^* + d_O^*) + \boldsymbol{k}(p_O^* + d_O^*)} E(c / c \geq p_O^* + d_O^*).$$

Interestingly, under OER the breach-threshold, $p_O^* + d_O^*$, can be larger or smaller than the breach threshold under RLR, which was $E(v)$. Lemma 3 determines the conditions at which the threshold under OER will be larger than the threshold under RLR.

Lemma 3
If $g(E(v))[1 - F(E(v))][E(c / c \geq E(v)) - E(v)] < f(E(v))G(E(v))[E(v) - E(v / v \leq E(v))],$
then $p_O^* + d_O^* < E(v).$

Comments:

        (a) Proof in the appendix.

(b) Notice that our result is different from Stole (1992). Stole showed that the efficient stipulated damages are always under-compensatory (and thus the penalty doctrine is justified). He showed in other words that $p_O^* + d_O^* < E(v)$ always holds. Yet, in our model this result does not always hold. If the condition is not satisfied we might have over-compensatory damages (even before considering the strategic effect of third parties, see Edlin and Schwartz (2003) for a concise summary of the literature). The difference between our paper and Stole's is due to the different informational structure and the new proposed OTE which Stole does not consider.

Interestingly, under OER the breach-threshold, there can be more or less breaches than under RLR. Lemma A4 determines the conditions at which OER will induce less breaches than RLR.

Lemma A4 *If* $p_O^* + d_O^* \geq E(v)$, *then OER contract induces less expected breach than RLR.*

Comments:

(c) Proof in the appendix.

The question that we are left with is whether RLR or OER yields a higher joint payoff. Proposition 1 summarizes.

Proposition 1:

In a regime of double-sided uncertainty where parties specific performance and liquidated damages clauses are honored, OER is Pareto superior to RLR, if $E(v / v \geq E(v)) > E(c / c \geq E(v))$.

Comments:

(a) Proof in the appendix.

(b) Observe that for OER to dominate RLR the Buyer's expected valuation should be greater than Seller's expected cost, conditioned that both values are higher than $E(v)$ Recall from Lemma A1 above that $E(v)$ is the threshold for optimal breach under RLR. Indeed, under RLR, whenever the Seller's costs are higher than this threshold, he will breach the contract. The interesting question is whether it is then efficient to breach the contract.

(c) Proposition 1 states that OER Pareto dominates RLR whenever Buyer's mean-valuation above the RLR breach-threshold is higher than the Seller's mean-costs above that threshold. Indeed, in that case, from the ex-ante perspective, performance is more likely to be efficient than breach. The Buyer is likely to value the good at more than the Seller's costs. Under these circumstances shifting from RLR to OER, and thus providing the Buyer with the option to insist on performance, is efficiency-enhancing.

(d) In the special case of uniform distributions, where c is distributed $U[\boldsymbol{m}_S - s, \boldsymbol{m}_S + s]$, and V is distributed $U[\boldsymbol{m}_B - b, \boldsymbol{m}_B + b]$, the condition stated in Proposition 1 can be reduced to: $\boldsymbol{m}_B - \boldsymbol{m}_S > s - b$. This means that OER dominates RLR whenever the difference between parties' means is larger than the half of the difference in their ranges. Observe that the range is a proxy for the uncertainty in the Buyer's ultimate valuation and the Seller's ultimate costs. Thus for OER to dominate RLR, the Buyer's uncertainty should be larger than the Seller's uncertainty, and this excess uncertainty should be larger than the initial mean advantage that the Buyer has over the Seller.[18] The intuition for this result is simple. Observe that OER leads to more performance than RLR. Given the Buyer's larger ex-ante mean, this is a move in the right direction. Yet, sometimes the Seller's range of costs can be so large, that he is likely to end up having very high costs. In that case it is better not perform the contract. The condition $\boldsymbol{m}_B - \boldsymbol{m}_S > s - b$ defines the balance between these two effects- the mean effect and the range effect.

(e) Because neither of the legal regimes is unconditionally superior, courts should allow the parties to choose the type of legal regime they prefer. Specifically, the Buyer should be allowed to offer the Seller either an RLR-like take-it-or-leave it contract, with $p_R, d_R,$

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[18] Ex-ante, the Buyer has always a larger mean-valuation then the Seller' mean costs . Otherwise, risk neutral parties would have never entered the contract in the first place.

or an OER-like contract with p_O, d_O. The Seller is indifferent as his expected payoff is always zero. But for the Buyer it does matter. As the Buyer can observe both distributions in Time 1, she will prefer the p_O, d_O contract whenever the condition stated in Proposition 1 is met; otherwise she will prefer the p_R, d_R contract. Buyer's choice of contracts renders this mechanism to be *always* Pareto superior to the current RLR regime. Proposition 2 summarizes:

Proposition 2

In a regime of double-sided uncertainty where parties specific performance and liquidated damages clauses are honored, the mechanism defined in comment (e) above is Pareto superior to RLR.

3.3 Two numerical examples

 3.3.1 A simple example- uniform distributions.

Suppose that due to the fluctuations in the market prices of the inputs, the Seller's cost of production, at Time 1, is normalized to be drawn from the uniform distribution f(.)= uniform [10,70]. Similarly, due to fluctuations in the market prices of the products the Buyer ultimately manufactures and sells, the Buyer's best estimate of her valuation, at Time 1, is normalized to be drawn from the uniform distribution g(.)=uniform [30,90]. This is each side's Time 1 estimation of its own valuation of the contract, as well as of the other party's valuation. Observe that risk neutral parties will enter the contract because Buyer's mean valuation, 60, is larger than Seller's mean production costs, 40. Table 1 compares the two legal regimes discussed.

Table 1- A Comparison of the Legal Regimes – liquidated damages

Applicable Rule	d	p	p^B	p^S
RLR	20.83	39.17	20.83	0
OER	11.11	38.89	22.22	0

Table 1 shows that the Buyer in Time 1 will prefers to switch from RLR to OER whereas the Seller is indifferent. In return to receiving a somewhat lower price ex-ante (38.89 instead of 39.17) the Seller gets a large discount in the damages he might need to pay in case of a breach. As can be seen, while maintaining Seller's payoff constant, the Buyer's expected payoff increased, making the switch a Pareto improvement.[19]

One may wonder whether the change in the joint payoff from 20.83 to 22.22 is important. Yet the reader should be aware that this is a 6.67% increase in the joint payoff just from writing a better contract. Moreover, the switch from specific performance to liquidated damages, a widely celebrated change by legal economists, yields a 4.1% increase in the joint payoff.[20]

Lastly, the reader should not be misled by the previous example to believing that OER are always better than RLR. It is only when the conditions in Proposition 1 above hold (as they do in the simple numerical example) that OER yields a higher joint payoff. The next example explores this point more rigorously.

3.3.2 A more complicated example- normal distributions.

When parties distributions are normally distributed, analytically solving the model for the contracts p_O, d_O and p_R, d_R becomes much harder. We therefore solved it numerically. First, without loss of generality, we assumed that the Buyer's valuations are normally distributed with a mean of 18.5 and a standard deviation of 2.5. Second, we assumed that the Seller's costs are normally distributed with a relatively low mean and

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[19] As shown in Lemma A2 in the appendix, the damages under OTE contracts will sometimes be larger than the damages under RLR and sometimes lower.
[20] Observe that under RLR the Seller agrees to a contract price of $39.17, which is below his mean costs. This is because the Seller knows that in the state of the word in which his costs are high (C>60) she does not have to perform and can get away with paying only $20.83.

standard deviation. Without loss of generality, we assumed the Seller's mean to equal 13.5 and standard deviation to equal 0.5. Third, we calculated p_O, d_O and p_R, d_R only to find the joint payoff for both the OER and the RLR contracts. Fourth, we plotted the *difference* between the joint payoffs. Fifth, we increased the uncertainty about the Seller's valuation (as represented by the standard deviation) by 0.1 and performed the above routine again. We continued doing these 5 steps and increasing the standard deviation by 0.1 until the standard deviation was equal 4.5. Observe at this point that we solved the model for a Seller whose mean valuation is relatively low, while manipulating the uncertainty about his valuation (as represented by the standard deviation) from a standard deviation of 0.5 (which is much lower than the Buyer' standard valuation) to a much larger of standard deviation of 4.5.

The sixth and last step was to increase the mean by 0.25 and do all the above steps again. Thus, in effect, we calculated the difference between the joint payoffs under OER and RLR for all iterations between the Buyer and the Seller, where the latter's valuation was assumed to be normally distributed with a mean between 13.5 to 18.5 and standard variation between 0.5 to 4. The next graph presents our results.

Graph 1- A Comparison of the Legal Regimes – liquidated damages
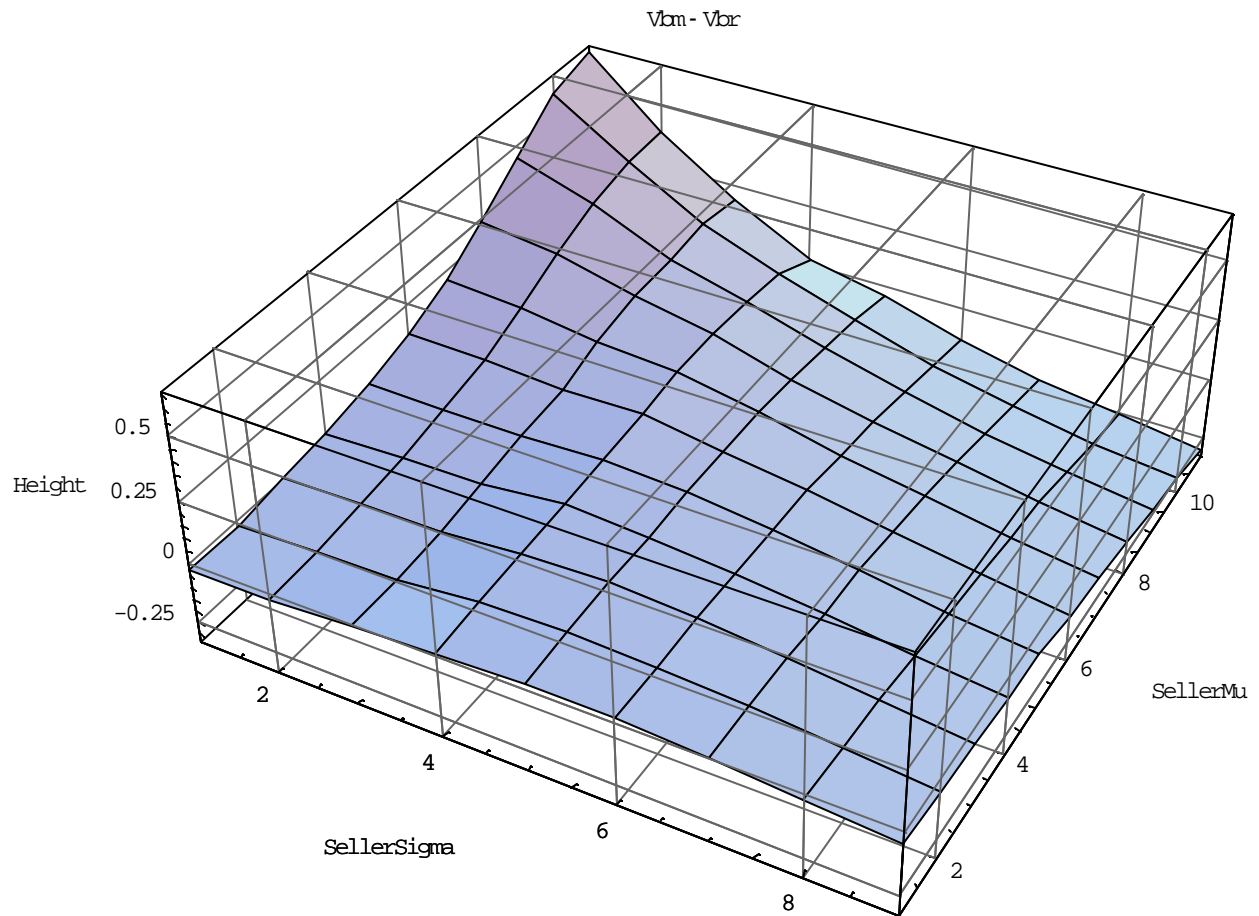
The Z-axis in Graph 1 presents the net difference between the joint payoffs under OTE and RLR. The net difference runs from -0.2 to 0.5, where the middle of the Z-axis is the zero point where both regimes yield the same joint payoff. The X-axis presents the Seller's possible standard deviations (runs from 0.5 to 4.5), whereas the Y axis presents his possible means (runs from 13.5 to 18.5).

Graph 1 shows that when the Seller's mean is relatively low, both regimes yield roughly the same joint payoff, irrespective of the relative difference between their respective standard deviations. The intuition behind this result is that when the Seller's costs are relatively low, he will always perform, so neither the RLR, which allows him to

breach and pay damages, or the OER which allows the Buyer to insist on performance, are required to induce performance.

Graph 1 also shows a "hill" at the upper left side and a "valley" at the upper right side of the graph. Starting with the "valley", Graph 1 shows that the larger the Seller's mean and standard deviations become, the more efficient RLR becomes relative to OER. The intuition is that when the parties' means become closer to each other, and, in addition, there is a lot of uncertainty regarding the Seller's ex-post cost of production, then there is a higher probability that the Seller's costs will exceed the Buyer' valuation. In those cases, a rule which grants the Seller the option to breach and pay damages will be more efficient. Indeed, this is exactly what RLR does.

Switching to the "hill" at the upper left side, Graph 1 shows that when the Seller's mean is large yet his standard deviation is small, the better OER becomes relative to RLR. The intuition is that when parties' means are close to each other, yet there is not much uncertainty about the Seller's ex-post cost of production, then there is a higher probability that the Buyer's valuation will exceed the Seller's costs. In those cases a rule which grants the Buyer the option to insist on performance will be more efficient. Indeed, this is exactly what OER does.


3.3 Comparative Statistics

3.3.1 A comparison of the price and damages under the two contracts.

Our numerical model enables us to take a closer look at the specific price and damages clauses that the parties will agree on. First consider the price difference between OER and RLR contracts. Since an OER contract makes the Seller worse off – he loses the power to unilaterally breach– one would expect that the Buyer will "compensate" the Seller for the switch from an RLR contract to an OER one. The Buyer could compensate the Seller by offering a higher price, by allowing the Seller to pay lower damages in case of a breach, or any combination the two. Indeed, that exactly what we find. Graphs 2a and 2b present the results.

Graph 2a- A Comparison of the Contract Price.
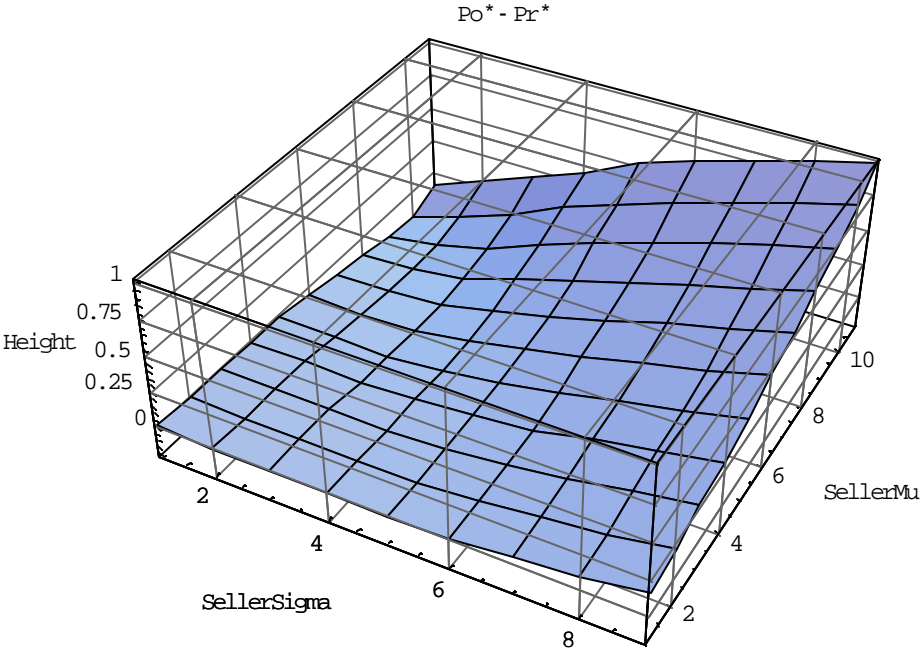
Graph 2b- A Comparison of the Contract Damages.
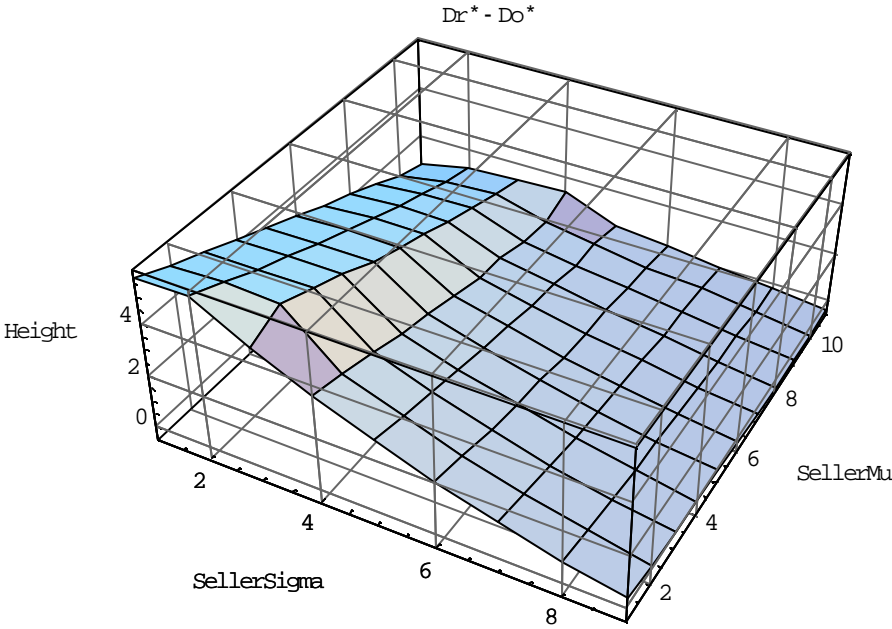
Graph 2a shows that in general the OER contract price is higher, except for a very small area where the Seller's sigma is extremely small and his mean is relatively large. Graph 2b shows that, in general, the damages in the OER contract are smaller, except for a very small area where both Seller's sigma and mean are very large.[21] Thus, for every possible iteration of the Seller's costs and the Buyer's valuation, the OER contract provides the Seller with either a higher price, or lower damages, or both.

3.4.2 The case of negative damages.

An interesting result of our research is that sometimes parties will agree on *negative* damages under the OTE contract. Graph 3 presents it.

Graph 3- The Stipulated Damages in an OTE contract.
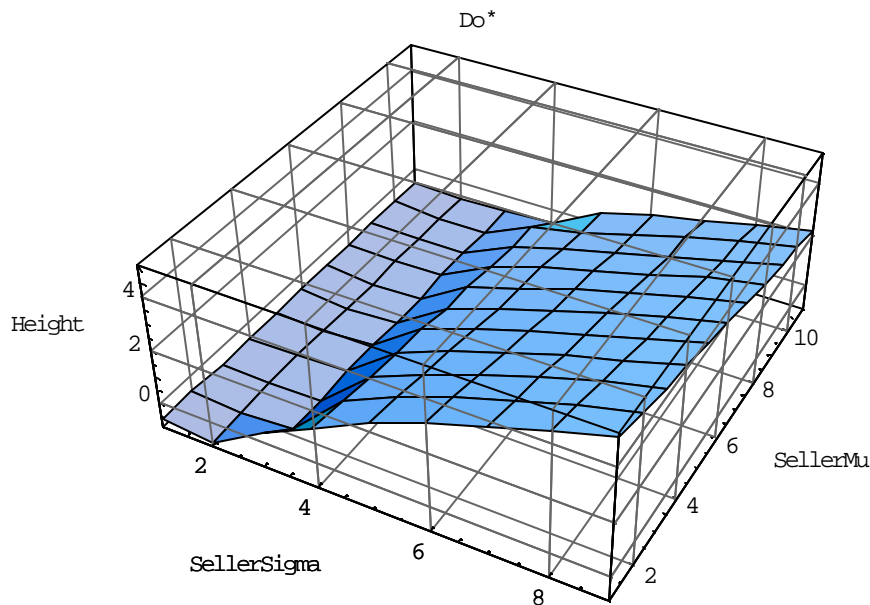
As graph 3 shows, when the Seller's sigma is relatively small, the stipulated damages that the Seller will have to pay in case of a contract breach are negative. That is,

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[21] The reader should recall the Seller's maximum mean is equal to the Buyer's mean.

in these circumstances, when the Seller attempts to breach the contract, the Buyer might well agree to *pay* to the Seller the predetermined stipulated amount in order to prevent the Seller from performing.[22]

To understand the intuition for this result we first have to observe two facts. First, for low sigmas the Seller's optimal breach threshold, $p_O^* + d_O^*$, is always smaller than the Seller's mean. That is, for low sigmas the following holds:

$$p_O^* + d_O^* < E[c]$$

Graph 4 presents this result.

Graph 4- The Stipulated Damages in an OER contract minus E[c].
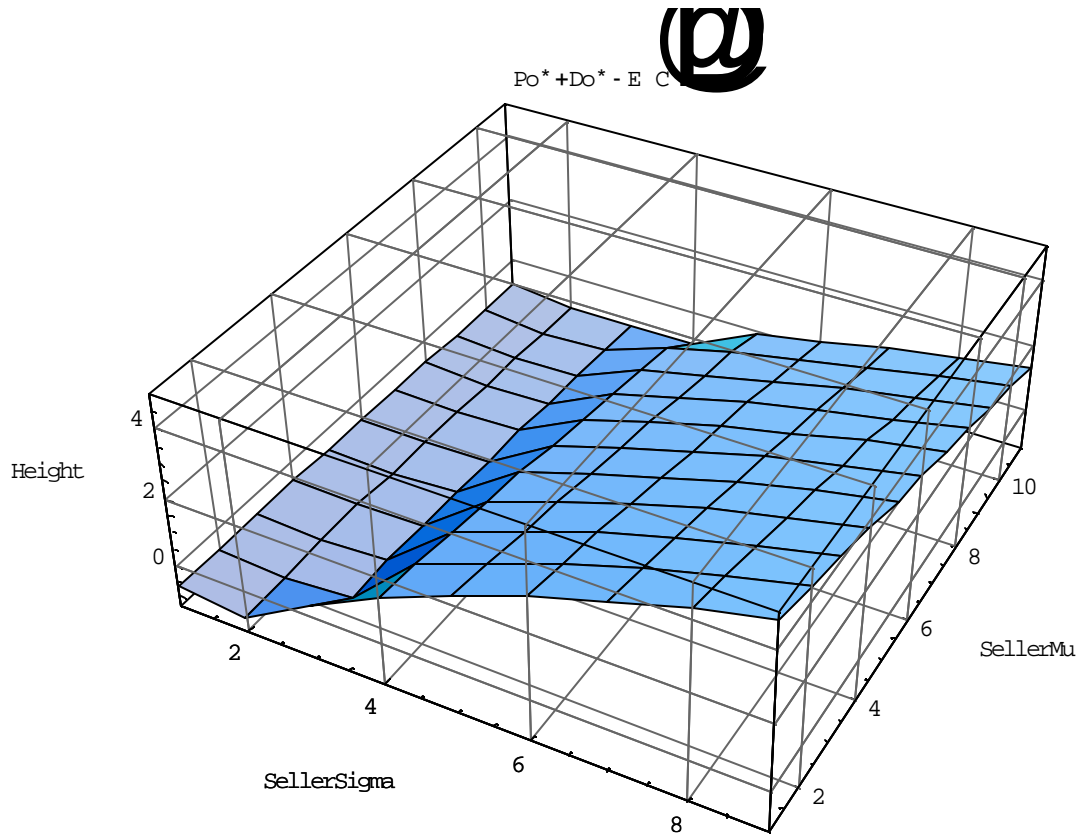
As Graph 4 shows, for a low sigma the breach threshold, $p_O^* + d_O^*$, minus the Seller's mean, E[c], is negative. This fact indicates that from the ex-ante perspective the

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[22] Compare to Ayres and $$, threats for in efficient performance.

Seller ex-post costs are most likely to exceed in these cases the breach threshold, $p_O^* + d_O^*$. This means that more likely than not, a Seller with a low sigma will attempt to breach because his costs are higher than the breach threshold.

However, the Buyer's mean, in general, is larger than the Seller's mean. Thus, from the ex-ante perspective the Buyer's ex-post valuation is, too, most likely to exceed the breach threshold. This means that the Buyer will most likely insist on performance in these cases.

To summarize, under the OER contract in cases of a Seller with a low sigma, the Seller will most likely want to breach, and the Buyer will most likely insist on performance.

The second fact to observe is that the price the Buyer offers in the OER contract, p_O^*, is also always smaller than the Seller's mean (no matter what the Seller's sigma is).[23] This fact indicates that the Seller gets a price, p_O^*, which does not over his expected costs for a contract which he will most likely have to perform. A risk neutral Seller might of course not agree to such a contract in the first place. To make it individually rational for the Seller to agree to such a contract, the Buyer must promise the Seller *negative* damages.

But under what circumstances would the Buyer be willing to pay negative damages? Sometimes the Buyer's ex-post valuation will be so low that she will prefer to pay the Seller *not* to perform. She will prefer this option on the alternative, which is to pay the full price p_O^* for a good for which her valuation is so low. From the Seller's perspective, the possibility for this rare expected profit in cases of a breach somewhat makes up for the more likely expected loss from performance.

A bit more concretely, for Sellers with low sigma, there is about a 75% chance that the Seller costs and the Buyer's valuation will both be higher than $p_O^* + d_O^*$. This means that in about 75% of the cases the Seller will want to breach but the Buyer will insist on performance. This means, that in about 75% of the cases the Seller is going to

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[23] To see this, observe that if the contract restricted the remedy to always being specific performance, then to keep the Seller's expected payoff equal to zero, the Buyer must have offered a price equal to the Seller's mean costs. Since in the OTE contract there are some cases where the Seller can avoid performance, the Buyer can offer a lower price.

lose money because he performed when his costs were high. To keep Seller's expected payoff at zero, so that it is individually rational for him to accept the contract the Seller must be promised to make some profit. There are two sources of revenue for him:

a) 10% of the time the Seller's costs will be lower than $p_O^* + d_O^*$ *and* Buyer's valuation will be higher than that threshold. Therefore, there will be efficient performance, but this is not enough to compensate the Seller for 75% of the times that she will lose money.

b) 15% of the time the Seller's costs will be higher than the threshold *and* the Buyer's valuation will be lower than the threshold. In those cases the Seller and the Buyer will both prefer to that the Seller breaches. In those cases the Seller will be able to receive negative damages from the Buyer.

3.5 The desirability of an ex-ante contract.

In our model parties are not required to make investments prior to the Seller's decision whether to breach and the Buyer's decision whether to agree or insist on performance. One may wonder whether parties would be better off waiting until they learn their valuations and then sign a contract. A contract at a later stage will be presumably more efficient, because more information is on the table.[24]

The reason that parties bother writing a contract at all at the ex-ante stage when no investments are required is that at this stage they are symmetrically informed, or more accurately, symmetrically uninformed. In contrast, in the interim stage after they learn their own valuations they are *a*symmetrically informed. Designing a contract under information asymmetry is not an easy task due to the parties' strategic behavior. Indeed, a contract designed in the interim stage is not necessarily more efficient than a contract designed in the ex-ante stage. The benefits from the increase of information in the interim stage does not necessarily outweigh the disadvantages of the parties' strategic attempts to extract more rent.

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[24] We thank Omri Ben-Shachar for bringing this to our attention.

Before we demonstrate this claim, it is useful to recall that scholars applying the mechanism design approach largely agree that parties cannot achieve the first best in the interim stage (Myerson & Satterthwaite (1983)), but they *can* achieve it in the ex-ante stage (D'Aspremont & Gerard-Varet (1979)), even when parties' investments are required (Rogerson (1992), Che & Hausch (1999)). This means that when contingent contracts are feasible meeting at the ex-ante stage is superior to meeting at the interim stage even though more information is on the table at the interim stage. Does that result carry to the non-contingent contracts world?

To check whether or not the ex-ante contract we described above is superior to a contract designed in the interim stage, we compared the joint expected payoff in both contracts. In the ex-ante contract described above, the Seller's expected payoff is always zero. Thus, the joint expected payoff in the contract is equal to the Buyer's expected payoff. This is not so in the interim contract. There, as we explain in more detail below, the Seller might well get some payoff.

Before we present the results, we need discuss interim contracting. There are many bargaining games that parties can play after they have learned their valuations. We chose the simplest game where the Buyer, who knows her own valuations and observes Seller's *distribution* of costs, makes the Seller a take-it-or-leave-it offer. If the Seller agrees, the good is traded; if he does not agree, the good is not traded. The Seller has no opportunity to breach, and therefore the Buyer has no opportunity to insist on performance. Renegotiation is not possible. This design is not only simple but also the closest design to the contract at the ex-ante stage. But the reader should bear in mind that our results below are restricted to this specific design.

The Buyer whose private valuation is v, makes a take-it-leave-it offer to purchase the good for a price, p_I. The Seller, whose private costs are c, either accepts it or rejects it.

The Buyer's problem is

$$\underset{p_I}{Max}\, F(p_I)(v - p_I)$$

The first-order condition gives us the implicit formula for the optimal price p_I^*:[25]

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[25] Notice that the assumption that the Seller with costs lower than this price accepts this offer depends heavily on the no-renegotiation assumption. Otherwise, depending on the negotiation game, the seller can infer the Buyer's value v from the offer $p_I^*(v)$, and might reject $p_I^*(v)$, only to make a counter-offer

(1) $p_I^* = v - F(p_I^*)/f(p_I^*)$

If the Seller's costs are higher than p_I^*, then he would reject the offer and both parties will have a payoff of zero; if the Seller's costs are lower than p_I^*, then the expected *interim* payoffs for the Buyer and the Seller are, respectively:

(2) $\boldsymbol{p}_I^B(v) = F(p_I^*)(v - p_I^*) = F^2(p_I^*)/f(p_I^*)$.

(3) $\boldsymbol{p}_I^S(c) = p_I^* - c = v - c - F(p_I^*)/f(p_I^*)$.

In order to compare the interim contract to the ex-ante contract, we need to account for all possible valuations, v, that the Buyer might have. Accordingly, from the ex-ante perspective, the expected payoffs of the interim contract is:

(2') $E\boldsymbol{p}_I^B = \int_{\underline{V}}^{\overline{V}} F^2(p_I^*(v))/f(p_I^*(v))dG(v)$

(3') $E\boldsymbol{p}_I^S = \int_{\underline{V}}^{\overline{V}} \int_{\underline{C}}^{p_I^*(v)} [v - c - F(p_I^*(v))/f(p_I^*(v))]dF(c)dG(v)$

And the total expected ex-ante payoff of the interim contract is:

(4) $E\boldsymbol{p}_I = \int_{\underline{V}}^{\overline{V}} \int_{\underline{C}}^{p_I^*(v)} (v - c)dF(c)dG(v)$

Graph 5 presents the difference between the joint expected payoff of the interim contract (from (4) above) and the joint expected payoff of the best ex-ante contract. Before we discuss the results, we would like to define the "best ex-ante contract." The "best ex-ante contract" is the contract that parties will enter at the ex-ante stage. It can be a RLR or an OTE, depending on their relative valuations. While both the RLR and the OTE yield on average higher joint payoff than the interim contract, the "best contract", naturally, yields an even higher joint payoff.

$p^S = v^{-1}(p_I^*)$ (i.e., the Buyer's value) to extract rent from the Buyer. A way to justify the no re-negotiation assumption is to imagine a single Buyer making a take-it-or-leave-it offers to many sellers, (whose costs are distributed along F). In such a scenario, all sellers whose costs are lower than the offer will accept the offer. The contract will then be signed with one of them with equal probability.

Graph 5- The Superiority of the Ex-ante contract on the Interim Contract

MaxVborVbm - JointInterim

Graph 5 shows that in general the best ex-ante contract is superior to the interim contract. On average the ex-ante contract yields 15% more joint payoff than the interim contract. There is an exception though. Whenever the Seller's mean is very close to the Buyer's mean, and Seller's sigma is relatively low, the parties would be better off to wait for the interim stage before they enter a contact.

3.6 The Two-Price contract.

So far we have assumed that in the OTE contract, if the Buyer insists on performance, she could get performance and still pay the original price, p_O. In this section we consider the possibility that the original contract will stipulate not only the original price and damages but also a Delta, where Delta is an additional price the Buyer needs to pay in case she insists on performance. Thus, the Buyer offers the following contract to the Seller: $(p_O, p_O + \Delta, d_o)$

Does a Two-Price contract yield a higher joint payoff than a Single-Price contract? On the one hand, there is a reason to be optimistic. This scenario is similar to an ascending auction because the Buyer who insists on the performance needs to add a Delta to compensate the Seller. In particular, in the first round the Seller attempts to breach because his ex-post costs are higher than $(p_O + d_o)$. When the Buyer insists on performance she reveals that her ex-post valuation is also higher than $(p_O + d_o)$. But from an ex-post efficiency perspective, we cannot know whether the Buyer's valuation is higher than the Seller's. A Two-Price contract, which demands the Buyer add a Delta if she insists on performance, brings us closer to first-best, because it tells us that the Buyer's valuation is not only higher than $(p_O + d_o)$ but also higher than $p_O + d_o + \Delta$. This effect should increase efficiency.

On the other hand, there is a reason to be pessimistic. In the Single-Price contract the Seller attempted to breach only if his costs were truly above the breach threshold, $(p_O + d_o)$. In contrast, in the Two-Price contract the Seller might strategically attempt to breach even if his costs are lower than the breach threshold. The Seller might breach in order to extract, with some probability, an extra Delta from the Buyer. This strategic behavior might decrease efficiency.

Which of the two effects is stronger? Intuitively, a Two-Price contract should be superior to our Single Price contract. A Single-Price contract is equivalent to a Two-Price contract where Delta is equal to zero. Thus, once the restriction that Delta is equal to zero is removed - as is the case of a Two-Price contract – one would expect the joint payoff to increase. Put differently, the Buyer who makes a take-it-or-leave-it offer knows that the

Seller might behave strategically and can always choose a Delta equal to zero to prevent it. If she chooses a Delta larger than zero, it must yield her a higher expected payoff. But since the Seller's expected payoff is equal to zero, a higher expected payoff for the Buyer entails a higher joint expected payoff.

More formally, we assume that the Buyer offers a take-it-or-leave-it contract $(p_O, p_O + \Delta, d_O)$ to the Seller. The Buyer will insist on performance if $v \geq p_O + d_O + \Delta$, and will agree to the breach otherwise. If the Seller performs, he will obtain a payoff of $p_O - c$; if he attempts to breach the contract, his expected payoff is

$G(p_O + d_O + \Delta)(-d_O) + [1 - G(p_O + d_O + \Delta)](p_O + \Delta - c)$. Hence, the Seller will perform

if $c \leq p_O + d_O + \Delta - \dfrac{\Delta}{G(p_O + d_O + \Delta)}$, and will attempt to breach otherwise.

Denote Seller's breach threshold $p_O + d_O + \Delta - \dfrac{\Delta}{G(p_O + d_O + \Delta)} \equiv x$, $p_O + d_O + \Delta \equiv y$.

The Buyer's expected payoffs is:

$$\boldsymbol{p}_O^B = F(x)[E(v) - p_O] + [1 - F(x)]\{G(y)d_O + [1 - G(y)][E(v|v \geq y) - p_O - \Delta]\}$$

$$= F(x)E(v) + [1 - F(x)][yG(y) + \int_y^{\bar{v}} vdG(v) - \Delta] - p_O$$

The Seller's expected payoffs is:

$$\boldsymbol{p}_O^S = F(x)[p_O - E(c|c \leq x)] + [1 - F(x)]\{G(y)(-d_O) + [1 - G(y)][p_O + \Delta - E(c|c \geq x)]\}$$

$$= p_O - E(c) + [1 - F(x)][\Delta - yG(y)] + G(y)\int_x^{\bar{c}} cdF(c)$$

As before the Buyer will maximize the joint payoff, then manipulate P_O to extract all surplus from the Seller. The Buyer's problem is:

$$\underset{\{p_O, d_O, \Delta\}}{Max} \boldsymbol{p}_O^B + \boldsymbol{p}_O^S = F(x)E(v) - E(c) + [1 - F(x)]\int_y^{\bar{v}} vdG(v) + G(y)\int_x^{\bar{c}} cdF(c)$$

The first-order conditions are:
For p_O or d_O:

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(1) $f(x)[1 + \Delta g(y)/G^2(y)][\int_{\underline{v}}^{y} vdG(v) - xG(y)] + g(y)\left\{\int_{x}^{\bar{c}} cdF(c) - y[1 - F(x)]\right\} = 0,$

for Δ:

(2) $f(x)[1 - \dfrac{1}{G(y)} + \Delta g(y)/G^2(y)][\int_{\underline{v}}^{y} vdG(v) - xG(y)] + g(y)\left\{\int_{x}^{\bar{c}} cdF(c) - y[1 - F(x)]\right\} = 0.$

Subtracting (4.12) from (4.11) gives us

(3) $\Delta = \int_{\underline{v}}^{y} G(v)dv$

It is easy to verify that $p_o^* + d_o^* + \Delta^* > \underline{v}$.[26] This implies that $\Delta > 0$, which means that the Buyer will never choose the Single-Price contract, despite Seller's strategic behavior.

(2) and (3) imply:

(4) $y = E(c|c \geq x) = E(c|c \geq y - \dfrac{\Delta}{G(y)})$,

The assumption that the Buyer makes a take-it-or-leave-it offer implies:

(5) $\boldsymbol{p}_o^S = p_O - E(c) + [1 - F(x)][\Delta - yG(y)] + G(y)\int_{x}^{\bar{c}} cdF(c) = 0$

From equations (4.13)-(4.15), we can solve for p_o^*, d_o^*, and Δ^*.

Before we end this section we would like to note that there is no reason to stop at a Two-Price contracts, with two rounds of exercising options. For example, a three-rounds-contract is also possible to imagine. After the Buyer insisted on performance in the second round (and paid Delta), then in the third round the Seller is allowed to insist on a breach. Yet, to breach at this point will require him to pay higher damages. Thus, at the ex-ante stage the Buyer offers the following contract to the Seller:

$(p_O, p_O + \Delta, d_O, d_O + \Phi)$, where $d_O + \Phi$ is the higher amount of damages that the Seller will need to pay when she breaches at the third round. We guess that at some round, N,

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[26] Because if $p_o^* + d_o^* + \Delta^* \leq \underline{v}$, then the Buyer will always insist performance, and the two-price Option-to-Enforce contract is equivalent to specific performance, ignoring both parties' private information. It induces lower efficiency than RLR which takes advantage of the Seller's private information. However, we can simply construct a feasible two-price Option-to-Enforce contract that is equivalent to RLR---- $p_O = p_R, d_O = d_R, p_O + \Delta = \bar{v}$. Therefore, $p_o^* + d_o^* + \Delta^* > \underline{v}$.

first best can be effectively achieved. Of course, a contract with N rounds is much harder to design. (See Ayres & Balkin (1996)). We this further in the Appendix.

4. Summary and Future Research.

In this paper we showed that with two-sided uncertainty parties can still do better themselves through contract-design than was previously thought. There is an intrinsic tension between, on the one hand, letting parties dictate their remedies at the time they enter the contract, and, on the other hand, letting the court make use of the information that has been revealed by the time of the breach. Our approach tries to take advantage of the good in both sides. We suggest allowing the parties to postpone choosing a remedy until they have learned the new information. In this way we keep the choice of remedy in the parties' hands, and allow them to take advantage of the new information revealed to them by them time of the breach.

A regime which allows the parties to agree, if they wish, to give the Buyer the option to enforce the contract is superior to a legal regime of specific performance and the current regime of damages.

We believe that the proposed contract clauses have some likelihood to be enforced by courts, assuming the new proposed changes in the UCC will be accepted. If courts in the future will respect liquidated damages clause and specific performance clause, we estimate they are likely to respect a clause which lets the aggrieved party to choose upon breach whether she prefers the liquidated damages or performance.

In his new book chapter on the economic analysis of contracts Steve Shavell argues that when courts are not able to determine the value of performance, parties will often want to write a liquidated damages clause. Shavell then mentions this would not be an option for the parties if the value of performance to the Buyer is uncertain. As an example Shavell says that "if the value of having a factory constructed on time will vary, due to market conditions for the product the Buyer is going to produce in the factory, then the parties cannot specify the damages to be paid in advance."[27] In this paper we

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[27] Discussion Paper No. 403, 02/2003. Footnote 77 and the text around it.

demonstrate that parties do have simple ways to solve this problem. We proposed a contract-clause which does that and argued that it is sometimes superior to the conventional alternatives. The new clause takes advantage of the information that the Seller and the Buyer receive between the time they entered the contract and the time of the breach. With the new changes in the law, especially in the UCC, we expect to find parties that employ the mechanism proposed in the paper.

There are several issues that we leave for future research. First, our model can be extended to analyze different information structures. Second, our model can be extended to account for re-negotiation between the Seller and the Buyer. Third, one can study optimal investment decisions, given our, or any other, information structure. Following Che and Hausch (1999), we believe that both self-investments and cooperative-investments are worth exploring. Fourth, it will be interesting to follow-up on the literature which accounted for third-party entrants. On this point, it is interesting to note that Chung (1992), for example, analyzed a case where the third-party's offer is observable to the original Buyer and Seller, but non-verifiable by the courts. He showed that if the potential entrant, the third party, has some bargaining power, first-best cannot be obtained. Chung assumed no renegotiation in his model and restricted his attention to one-sided uncertainty. Spier & Whinston (1995) studied an environment where the Buyer's value, the Seller's cost and the entrant's offer are observable to all parties; the only uncertainty arises from the entrant's offer. In that information structure one can safely assume, as Spier and Whinston did, that efficient renegotiation is feasible. Efficient renegotiation is certainly more difficult to attain when all parties have private information, as in our model. Lastly, Hua 2003 studied an ex-ante contract between a Buyer and a Seller which essentially provides the Buyer some strategic advantage against a potential new Buyer who later arrives. Hua showed that the original Buyer and Seller can jointly extract rent from the new Buyer. Interestingly, Hua shows that even such an ex-ante strategic contract can nevertheless be more socially efficient than the absence of such contract because it mitigates the Seller's ex-post rent seeking vis-à-vis the original Buyer. Hua's model, however, assumes one sided-uncertainty and no renegotiation or investments.

<u>5. Appendix.</u>

5.1 General

A Buyer (B) and a Seller (S) are trading an indivisible good. Seller's cost c is random over the interval $[\underline{c}, \overline{c}]$, with distribution $F(c)$. Buyer's value (v) is distributed according to $G(v)$ over the interval $[\underline{v}, \overline{v}]$. F(.) and G(.) are common knowledge. $E(v) \geq E(c)$ (There are trading opportunities ex ante).

We focus our attention on the ex-ante design of the contract in light of expected future new information and, therefore, assume no renegotiation or investments are involved. We study a model where the Seller is only party who can breach.

The following is a standard *Monotone Hazard Rate* assumption we will use in our analysis:

<u>*Assumption A1*</u> $\dfrac{1 - F(x)}{f(x)}$ and $\dfrac{g(x)}{G(x)}$ are decreasing in x.

<u>Subscripts</u> O (R) denote values under OER (RLR) in the liquidated damages model.

Legal Regimes comparison----- Under *Regular Legal Regime (RLR),* the Seller has the right to breach if he pays the damages to the Buyer. Under *Option to Enforce Regime (OER),* the Buyer has an option to insist, upon breach, on performance. While under RLR, only the Seller can take advantage of his future private information, but under OER both parties can take advantage of their future private information in making the breach decision.

Social Optimum----- Efficient breach: breach whenever $c > v$.

5.2 Stipulated Damages Models

We explore below several models. We start with a Single-Price contract.

4.2.1 A Single-Price Contract

The RLR Contract

Time Line-----At Time 1, when the parties sign the contract, they do not know their exact valuation and cost, but only know their distributions. At time 1.5, parties learn their private information. At Time 2 the Seller decides whether or not to deliver the good. At Time 3, the court enforces the contract that the parties signed in Time 1.

Under *Regular Legal Regime (RLR),* the Seller has the right to breach if he pays the damages to the Buyer. We assume that the Buyer makes the Seller a take-it-or-leave-it

offer with a fixed price and liquidated damages contract, (p_R, d_R)[28]. The price, p_R, is payable upon performance. The Seller will get $p_R - c$ if he performs, or $-d_R$ if he breaches. Therefore, he will breach if $c > p_R + d_R$ ($p_R + d_R$ is the breach-threshold).

To simplify the analysis, we assume that F and G are independent. Our main result is not affected by introducing correlated valuations, but it will complicate our analysis.

If the contract is accepted by the Seller, the Buyer will get this expected payoff:

$$p_R^B = F(p_R + d_R)[E(v) - p_R] + [1 - F(p_R + d_R)]d_R, \tag{5.1}$$

and the Seller's expected payoff (if he accepts the contract) is:

$$p_R^S = F(p_R + d_R)[p_R - E(c/c \le p_R + d_R)] + [1 - F(p_R + d_R)](-d_R)$$
$$= F(p_R + d_R)(p_R + d_R) - \int_{\underline{c}}^{p_R + d_R} c\,dF(c) - d_R. \tag{5.2}$$

The Buyer chooses $(p_R + d_R)$ to maximize the joint payoff, and then manipulates the price to guarantee the Seller a zero expected payoff. (Of course, *ex post* the Seller might get some positive surplus as his informational rent since he possesses private information about his then-realized production cost).

$$\underset{p_R + d_R}{Max} \; p_R^B + p_R^S = F(p_R + d_R)E(v) - \int_{\underline{c}}^{p_R + d_R} c\,dF(c)$$

Taking the first-order condition and setting the Seller's expected payoff as zero, the equilibrium conditions are:

$$\begin{cases} [E(v) - (p_R + d_R)]f(p_R + d_R) = 0 & (5.3) \\ F(p_R + d_R)(p_R + d_R) - \int_{\underline{c}}^{p_R + d_R} c\,dF(c) - d_R = 0 & (5.4) \end{cases}$$

Lemma 1 *Under RLR with Liquidated Damages, the equilibrium is:*

$$d_R^* = p_R^{B^*} = \int_{\underline{c}}^{E(v)} F(c)dc,$$

$$p_R^* = E(v) - d_R^* = E(v) - \int_{\underline{c}}^{E(v)} F(c)dc.$$

Proof: p_R^* and d_R^* are directly derived from equations (5.3) and (5.4). QED.

Observe from Lemma A1 that $d_R^* = E(v) - p_R^*$, i.e., in equilibrium, the contract will set *expected expectation damages*.

Example: If both parties' distributions are uniform on [0,100], then d_R^*=12.5, p_R^*=37.5, $p_R^{B^*} = 12.5$. If F is U[10,70] and G is U[30,90], then d_R^*=20.83, p_R^*=39.17, $p_R^{B^*} = 20.83$.)

The OER Contract

Under *Option to Enforce Regime (OER)* the Buyer has an option to insist, upon breach, on performance. We still assume that Buyer makes a take-it-or-leave-it offer (p_O, d_O) to the Seller. If upon anticipatory breach the Buyer insists on performance, she gets $v - p_O$; if she does not insist on performance, she gets d_O. Therefore, the Buyer will insist on performance if $v \geq p_O + d_O$ and agree to the liquidated damages otherwise.

If the Seller performs, he gets $p_O - c$. If he is allowed to breach he will get $(-d_O)$. Observe that under OER, the Seller can no longer unilaterally decide on breach. If the Buyer insists on performance the Seller will have to perform. The Seller's expected payoff therefore when he attempts to breach is $G(p_O + d_O)(-d_O) + [1 - G(p_O + d_O)](p_O - c)$. Hence, if $c \geq p_O + d_O$, the Seller will prefer to breach, otherwise he will deliver. Thus, $(p_O + d_O)$ is also the Seller's breach threshold.

The Buyer's expected payoff is:
$$p_O^B = F(p_O + d_O)[E(v) - p_O]$$
$$+ [1 - F(p_O + d_O)]\{G(p_O + d_O)d_O + [1 - G(p_O + d_O)][E(v/v \geq p_O + d_O) - p_O]\}$$
$$= F(p_O + d_O)E(v) - [1 - G(p_O + d_O) + F(p_O + d_O)G(p_O + d_O)]p_O$$
$$+ [1 - F(p_O + d_O)]\left\{ G(p_O + d_O)d_O + \int_{p_O + d_O}^{\bar{v}} v dG(v) \right\}, \qquad (5.5)$$

and the expected payoff of the Seller is:
$$p_O^S = F(p_O + d_O)[p_O - E(c/c \leq p_O + d_O)]$$
$$+ [1 - F(p_O + d_O)]\{G(p_O + d_O)(-d_O) + [1 - G(p_O + d_O)][p_O - E(c/c \geq p_O + d_O)]\}$$
$$= [1 - G(p_O + d_O) + F(p_O + d_O)G(p_O + d_O)]p_O$$
$$- [1 - F(p_O + d_O)]G(p_O + d_O)d_O - E(c) + G(p_O + d_O) \int_{p_O + d_O}^{\bar{c}} c dF(c) \qquad (5.6)$$

As before, the Buyer can chose $(p_o + d_o)$ to maximize the joint payoff, and then manipulate the price to guarantee the Seller a zero expected payoff.

$$\underset{p_o+d_o}{Max}\, \boldsymbol{p}_O^B + \boldsymbol{p}_O^S = F(p_o + d_o)E(v) + [1 - F(p_o + d_o)] \int_{p_o+d_o}^{\bar{v}} v dG(v)$$

$$+ G(p_o + d_o) \int_{p_o+d_o}^{\bar{c}} c dF(c) - E(c)$$

The first-order condition is:

$$[\int_{\underline{v}}^{p_o+d_o} v dG(v) - (p_o + d_o)G(p_o + d_o)]f(p_o + d_o)$$

$$+ \left\{ \int_{p_o+d_o}^{\bar{c}} c dF(c) - (p_o + d_o)[1 - F(p_o + d_o)] \right\} g(p_o + d_o) = 0, \qquad (5.7)$$

and setting the Seller's expected payoff to be zero gives us another equilibrium condition:

$$\boldsymbol{p}_O^S = [1 - G(p_o + d_o) + F(p_o + d_o)G(p_o + d_o)]p_o$$

$$- [1 - F(p_o + d_o)]G(p_o + d_o)d_o - E(c) + G(p_o + d_o)\int_{p_o+d_o}^{\bar{c}} c dF(c) = 0 \qquad (5.8)$$

Let $h(x) = \dfrac{f(x)}{1 - F(x)}, k(x) = \dfrac{g(x)}{G(x)}$, we have the following Lemma:

LemmaA2

$$\boldsymbol{p}_O^{B^*} = F(p_O^* + d_O^*)E(v) - E(c) + G(p_O^* + d_O^*)\int_{p_O^*+d_O^*}^{\bar{c}} c dF(c) + [1 - F(p_O^* + d_O^*)]\int_{p_O^*+d_O^*}^{\bar{v}} v dG(v),$$
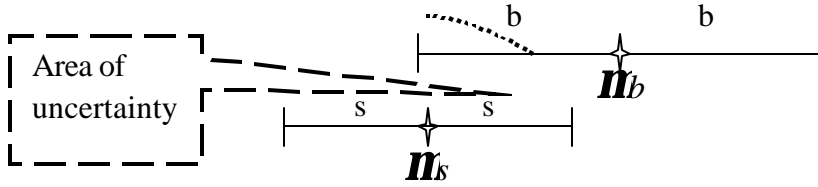
where $p_O^* + d_O^*$ is the solution to

$$p_O^* + d_O^* = \frac{h(p_O^* + d_O^*)}{h(p_O^* + d_O^*) + k(p_O^* + d_O^*)} E(v / v \le p_O^* + d_O^*)$$

$$+ \frac{k(p_O^* + d_O^*)}{h(p_O^* + d_O^*) + k(p_O^* + d_O^*)} E(c / c \ge p_O^* + d_O^*) \qquad (5.9)$$

Proof: Directly from equations (5.7) and (5.8)   QED.

The interpretation of (5.9) is that the optimal breach threshold, $p_O^* + d_O^*$, is the weighted sum of the lower-than-threshold truncated Buyer's expected value and the higher-than-threshold truncated Seller's expected cost (in this situation the Seller will propose breach and it will be accepted by the Buyer).

Example: If F is U[10,70], G is U[30,90], then $p_O^* = 38.89, d_O^* = 11.11, \boldsymbol{p}_O^{B^*} = 22.22$. Observe that $\boldsymbol{p}_O^{B^*} = 22.22 > 20.83 = \boldsymbol{p}_R^{B^*}$.

More generally, for example, if c is distributed $U[\boldsymbol{m}_S - s, \boldsymbol{m}_S + s]$, and v is distributed $U[\boldsymbol{m}_B - b, \boldsymbol{m}_B + b]$, then we derive from (8): $p_O^* + d_O^* = [(\boldsymbol{m}_S + s) + (\boldsymbol{m}_B - b)]/2$. The optimal threshold point is the midpoint of the Buyer's lower-bound and Seller's upper-bound values. It is the midpoint of the specific intersection of parties' distributions in which the uncertainty whether Buyer's valuation or the Seller's cost is greater exists (in all other parties' distributions, the choice is easy). The following diagram represents it:

Interestingly, under OER, the breach threshold, $p_O^* + d_O^*$, can be larger or smaller than the breach threshold under RLR, which was $E(v)$. Lemma A3 determines the conditions at which the threshold under OER will be larger than the threshold under RLR.

Lemma 3
If $g(E(v))[1 - F(E(v))][E(c/c \geq E(v)) - E(v)] < f(E(v))G(E(v))[E(v) - E(v/v \leq E(v))]$, then $p_O^* + d_O^* < E(v)$.

Proof: The first order condition, (4.7), can be rewritten as:

$$\Gamma(p_O^* + d_O^*) = -f(p_O^* + d_O^*)G(p_O^* + d_O^*)[(p_O^* + d_O^*) - \frac{\int_{\underline{v}}^{p_O^* + d_O^*} v dG(v)}{G(p_O^* + d_O^*)}]$$

$$+ g(p_O^* + d_O^*)[1 - F(p_O^* + d_O^*)][\frac{\int_{p_O^* + d_O^*}^{\bar{c}} c dF(c)}{1 - F(p_O^* + d_O^*)} - (p_O^* + d_O^*)]$$

$$= g(p_O^* + d_O^*)[1 - F(p_O^* + d_O^*)][E(c/c \geq p_O^* + d_O^*) - (p_O^* + d_O^*)]$$

$$- f(p_O^* + d_O^*)G(p_O^* + d_O^*)[(p_O^* + d_O^*) - E(v/v \leq p_O^* + d_O^*)] = 0$$

If $g(E(v))[1 - F(E(v))][E(c/c \geq E(v)) - E(v)] < f(E(v))G(E(v))[E(v) - E(v/v \leq E(v))]$, then $\Gamma(E(v)) < 0$. The second-order condition implies that $\Gamma' < 0$, hence we have $p_O^* + d_O^* < E(v)$.   Q.E.D

Remarks: 1. Lemma A3 suggests that two relative effects around the critical value $E(v)$ (which is the optimal breach threshold under RLR) determine whether $p_O^* + d_O^*$ is above or below $E(v)$. Lets first assume that under OER, we still set the breach threshold at $E(v)$. Then one effect is in force when the Buyer's value is $E(v)$ (probability $g(E(v))$), and the Seller's cost of performance is above $E(v)$ (this happens with probability $1 - F(E(v))$). In this case, the Seller wants to breach but the Buyer is indifferent between breach and performance. Breach is efficient in this case, and the Seller's expected cost savings from successful breach is the forgone expected cost minus the damages that he would have needed to pay, $E(v)$. The other effect occurs when the Seller's cost is $E(v)$ (probability $f(E(v))$), and the Buyer's value of performance is below $E(v)$ (this happens with probability $G(E(v))$). In this case, the Buyer wants the Seller to breach, but the Seller is indifferent between breach and performance. Breach is efficient in this case, and the Buyer's expected gain from breach is the damages she would have received, $E(v)$, minus her expected value of the good. If the first effect is dominated by the second effect, the Buyer (contract designer) will have an incentive to lower the breach threshold to below $E(v)$ to encourage more breach from the Seller.

2. Notice that our result is different from Stole (1992). Stole showed that the stipulated damages optimally set by private parties are always under-compensatory (and thus the penalty doctrine is justified). He showed in other words that $p_O^* + d_O^* < E(v)$ always holds in his model. Yet, in our model this result does not always hold. If the condition is not satisfied we might have over-compensatory damages (even before considering the strategic effect of third parties, see Edlin and Schwartz (2003) for a concise summary of the literature). The difference between our paper and Stole's is due to the different informational structures[29], and the new proposed OER, which Stole does not consider.

We also have the following Lemma comparing the relative breach frequency of the two regimes.

<u>Lemma 4</u> *If $p_O^* + d_O^* \geq E(v)$, then OER contract induces less expected breach than RLR.*
Proof: Under RLR, if $c > p_R^* + d_R^* = E(v)$, i.e., with probability $1 - F(E(v))$ the Seller breaches. Under OER contract the Seller breaches only if $c > p_O^* + d_O^* = a$ and $v < p_O^* + d_O^* = a$. This will happen with probability $[1 - F(a)]G(a)$. But $[1 - F(a)]G(a) \leq [1 - F(E(v))]G(a) < 1 - F(E(v))$. QED.

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[29] While we study ex-ante contracting (contracting between uninformed parties), Stole studies interim contracting (contracting between privately informed parties).

Comparison of Equilibrium Payoffs for OER and RLR

Lemma 1 and 2 imply that:

$$\boldsymbol{p}_O^{B^*} - \boldsymbol{p}_R^{B^*} = F(p_O^* + d_O^*)E(v) - E(c) + G(p_O^* + d_O^*) \int_{p_O^* + d_O^*}^{\bar{c}} cdF(c)$$

$$+ [1 - F(p_O^* + d_O^*)] \int_{p_O^* + d_O^*}^{\bar{v}} vdG(v) - F(E(v))E(v) + \int_{\underline{c}}^{E(v)} cdF(c)$$

$$= [F(p_O^* + d_O^*) - F(E(v))]E(v) - \int_{E(v)}^{\bar{c}} cdF(c)$$

$$+ G(p_O^* + d_O^*) \int_{p_O^* + d_O^*}^{\bar{c}} cdF(c) + [1 - F(p_O^* + d_O^*)] \int_{p_O^* + d_O^*}^{\bar{v}} vdG(v) \qquad (5.10)$$

Proposition 1

In a regime of double-sided uncertainty where parties' specific performance and liquidated damages clauses are honored, OER is Pareto superior to RLR, if $E(v/v \geq E(v)) > E(c/c \geq E(v))$.

Proof: Let $p_O + d_O = E(v)$, $p_O = x$, then the Seller's expected payoff is:

$$\boldsymbol{p}_O^S \Big|_{p_O + d_O = E(v), p_O = x} = [1 - G(E(v)) + F(E(v))G(E(v))]x$$

$$- [1 - F(E(v))]G(E(v))[E(v) - x] - E(c) + G(E(v)) \int_{E(v)}^{\bar{c}} cdF(c)$$

$$= x - E(c) + G(E(v)) \int_{E(v)}^{\bar{c}} cdF(c) - [1 - F(E(v))]G(E(v))E(v)$$

Let $\boldsymbol{p}_O^S = 0$, we have $p_O = E(c) - G(E(v)) \int_{E(v)}^{\bar{c}} cdF(c) + [1 - F(E(v))]G(E(v))E(v)$. Since

this price plus $d_O = E(V) - p_O$ guarantees the Seller's expected payoff is zero, it is a feasible contract. Plugging this specific contract into the Buyer's payoff function and simplifying, we get

$$\boldsymbol{p}_O^B \Big|_{p_O = E(c) - G(E(v)) \int_{E(v)}^{\bar{c}} cdF(c) + [1 - F(E(v))]G(E(v))E(v), d_O = E(v) - p_O}$$

$$= F(E(v))E(v) + [1 - F(E(v))] \int_{E(v)}^{\bar{v}} vdG(v) - E(c) + G(E(v)) \int_{E(v)}^{\bar{c}} cdF(c)$$

and we have

$$\boldsymbol{p}_O^B \Big|_{p_O=E(c)-G(E(v))\int_{E(v)}^{\bar{c}}cdF(c)+[1-F(E(v))]G(E(v))E(v),d_O=E(v)-p_O} - \boldsymbol{p}_R^{B^*}$$

$$= F(E(v))E(v)+[1-F(E(v))]\int_{E(v)}^{\bar{v}}vdG(v)-E(c)+G(E(v))\int_{E(v)}^{\bar{c}}cdF(c)$$

$$- F(E(v))E(v)+\int_{\underline{c}}^{E(v)}cdF(c)$$

$$= [1-F(E(v))]\int_{E(v)}^{\bar{v}}vdG(v)-[1-G(E(v))]\int_{E(v)}^{\bar{c}}cdF(c)$$

$$= [1-F(E(v))][1-G(E(v))][E(v/v\geq E(v))-E(c/c\geq E(v))] > 0$$

By the optimality of p_O^* and d_O^*, we have

$$\boldsymbol{p}_O^{B^*} = \boldsymbol{p}_O^B \Big|_{p_O^*,d_O^*} \geq \boldsymbol{p}_O^B \Big|_{p_O=E(c)-G(E(v))\int_{E(v)}^{\bar{c}}cdF(c)+[1-F(E(v))]G(E(v))E(v),d_O=E(v)-p_O} \quad \text{, therefore,}$$

$$\boldsymbol{p}_O^{B^*} - \boldsymbol{p}_R^{B^*} \geq \boldsymbol{p}_O^B \Big|_{p_O=E(c)-G(E(v))\int_{E(v)}^{\bar{c}}cdF(c)+[1-F(E(v))]G(E(v))E(v),d_O=E(v)-p_O} - \boldsymbol{p}_R^{B^*} > 0 \quad \text{if}$$

$$E(v/v\geq E(v)) > E(c/c\geq E(v)). \qquad\qquad QED$$

Remarks:

1. The condition $E(v/v\geq E(v)) = \dfrac{\int_{E(v)}^{\bar{v}}vdG(v)}{1-G(E(v))} > \dfrac{\int_{E(v)}^{\bar{c}}cdF(c)}{1-F(E(v))} = E(c/c\geq E(v))$ says that

the Buyer's expected valuation is greater than the Seller's expected cost, provided that both of them are over $E(v),$ which is the optimal breach threshold under RLR. Under RLR, when the Seller's cost is over the threshold, he will breach and trade is not realized. Proposition 1 states that OER Pareto dominates RLR whenever the Buyer's mean-valuation above the breach-threshold is higher than the Seller's mean-costs above that threshold. Indeed, in that case, from the ex-ante perspective, performance is more likely to be efficient than breach. Under these circumstances shifting from RLR to OER and thus providing the Buyer with the option to insist on performance is efficiency-enhancing.

2. In the special case of uniform distributions, where c is distributed $U[m_S - s, m_S + s]$, and v is distributed $U[m_B - b, m_B + b]$, the condition stated in Proposition 1 can be reduced to: $m_B - m_S > s - b$. This means that OER dominates RLR whenever the difference between parties' means is larger than half of the difference in their ranges. Observe that the range is a proxy for the uncertainty in the Buyer's ultimate valuation and the Seller's ultimate costs. Thus, for OER to <u>not</u> dominate RLR, the Seller's uncertainty should be larger than the Buyer's uncertainty, and this excess uncertainty should be larger than the initial mean advantage that the Buyer has over the Seller.[30] The intuition for this result is simple. Observe that OER leads to more performance than RLR. Given the Buyer's larger ex-ante mean, this is a move in the right direction. Yet, sometimes the Seller's range of costs can be so large that he is likely to end up having very high costs. In that case it would be better not perform the contract. The condition $m_B - m_S > s - b$ defines the balance between these two effects.

3. Because neither of the legal regimes is unconditionally superior, courts should allow the parties to choose the type of legal regime they prefer. Specifically, the Buyer should be allowed to offer the Seller either an RLR-like take-it-or-leave it contract, with p_R, d_R, or an OER-like with p_O, d_O. The Seller is indifferent as his expected payoff is always zero. But for the Buyer it is important. As the Buyer can observe in Time 1 both distributions, she will prefer the p_O, d_O contract whenever the condition stated in Proposition 1 is met, otherwise she will prefer the p_R, d_R contract. Buyer's choice of contracts renders this mechanism to be *always* Pareto superior to the current RLR regime. Proposition 2 summarizes:

Proposition 2   In a regime of double-sided uncertainty where parties' specific performance and liquidated damages clauses are honored, the mechanism defined in Remark 3 above is Pareto superior to RLR.

---

[30] Ex-ante, the Buyer has always a larger mean-valuation than the Sellers' mean costs. Otherwise, risk-neutral parties would have never entered into the contract in the first place.

4.2.2 Two-Price Contract

The reason why we can not obtain a general Pareto superiority of OER over RLR contracts is that we confine ourselves to solving for a single-price contract. As is clearly seen from the game tree below of an OER contract, there are two cases of performance---one is the Seller's voluntary performance in the first place; the other is when the Seller's breach attempt is vetoed by the Buyer, and the Seller needs to perform. But by a better contract design one can differentiate these two cases. Both parties can agree at Time 1 that the Buyer will pay the Seller p_O for voluntary performance, and will pay the Seller $p_O + \Delta$ in case of involuntary performance.
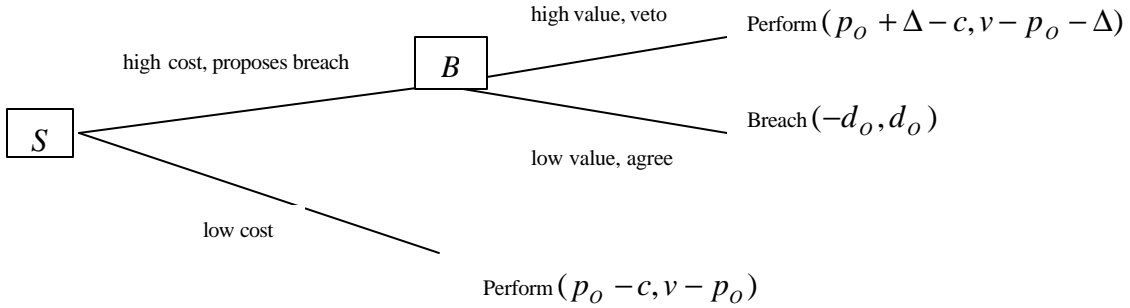

Figure 2. Option-to-Enforce game with two-price contract

In this contract, the Buyer offers a take-it-or-leave-it contract $(p_O, p_O + \Delta, d_o)$ to the Seller. The game and the corresponding payoffs are included in Figure 2. First, from the Buyer's perspective, when facing a breach attempt by the Seller, she will block the attempt, will insist on performance if $v \geq p_O + d_o + \Delta$, and will agree to breach otherwise. Second, from the Seller's perspective, if he performs, he will obtain a payoff of $p_O - c$; if he attempts to breach, his expected payoff is:
$G(p_O + d_o + \Delta)(-d_o) + [1 - G(p_O + d_o + \Delta)](p_O + \Delta - c)$. Hence, he will perform if
$c \leq p_O + d_o + \Delta - \dfrac{\Delta}{G(p_O + d_o + \Delta)}$ and will propose a breach otherwise.

Denote $p_O + d_o + \Delta - \dfrac{\Delta}{G(p_O + d_o + \Delta)} \equiv x$, $p_O + d_o + \Delta \equiv y$, the expected payoffs of the parties are as follows:

$$p_O^B = F(x)[E(v) - p_o] + [1 - F(x)]\{G(y)d_o + [1 - G(y)][E(v|v \geq y) - p_o - \Delta]\}$$

$$= F(x)E(v) + [1 - F(x)][yG(y) + \int_y^{\bar{v}} vdG(v) - \Delta] - p_o$$

$$p_O^S = F(x)[p_o - E(c|c \leq x)] + [1 - F(x)]\{G(y)(-d_o) + [1 - G(y)][p_o + \Delta - E(c|c \geq x)]\}$$

$$= p_o - E(c) + [1 - F(x)][\Delta - yG(y)] + G(y)\int_x^{\bar{c}} cdF(c)$$

The Buyer will maximize the joint payoff, and then manipulate p_o to extract all the surplus from the Seller. The Buyer's problem is:

$$\underset{\{p_o, d_o, \Delta\}}{Max} p_O^B + p_O^S = F(x)E(v) - E(c) + [1 - F(x)]\int_y^{\bar{v}} vdG(v) + G(y)\int_x^{\bar{c}} cdF(c)$$

The first-order conditions are:

For p_o or d_o:

$$f(x)[1 + \Delta g(y)/G^2(y)][\int_{\underline{v}}^y vdG(v) - xG(y)] + g(y)\left\{\int_x^{\bar{c}} cdF(c) - y[1 - F(x)]\right\} = 0, \qquad (5.11)$$

for Δ:

$$f(x)[1 - \frac{1}{G(y)} + \Delta g(y)/G^2(y)][\int_{\underline{v}}^y vdG(v) - xG(y)] + g(y)\left\{\int_x^{\bar{c}} cdF(c) - y[1 - F(x)]\right\} = 0. (5.12)$$

Subtracting (5.12) from (5.11) gives us

$$\Delta = \int_{\underline{v}}^y G(v)dv \qquad (5.13)$$

It is easy to verify that $p_o^* + d_o^* + \Delta^* > \underline{v}$.[31] This implies that $\Delta > 0$.
(5.12) and (5.13) imply

$$y = E(c|c \geq x) = E(c|c \geq y - \frac{\Delta}{G(y)}), \qquad (5.14)$$

also, we have

---

[31] Because if $p_o^* + d_o^* + \Delta^* \leq \underline{v}$, then the Buyer will always insist performance, and the two-price Option-to-Enforce contract is equivalent to specific performance, ignoring both parties' private information. It induces lower efficiency than RLR which takes advantage of the Seller's private information. However, we can simply construct a feasible two-price Option-to-Enforce contract that is equivalent to RLR---- $p_O = p_R, d_O = d_R, p_O + \Delta = \bar{v}$. Therefore, $p_o^* + d_o^* + \Delta^* > \underline{v}$.

$$\boldsymbol{p}_O^S = p_O - E(c) + [1 - F(x)][\Delta - yG(y)] + G(y)\int_x^{\bar{c}} c \, dF(c) = 0 \tag{5.15}$$

From equations (5.13)-(5.15), we can solve for p_o^*, d_o^*, and Δ^*.

Proposition 3 A Two-Price OER contract is always Pareto superior to:

    a)   The RLR contract

    b)   The Single Price OTE contract

Proof: As explained in footnote 4, if we choose $p_O = p_R, d_O = d_R, p_O + \Delta = \bar{v}$, then the resulting OER contract is equivalent to the optimal RLR contract. Similarly, if we choose $p_O = p_O, d_O = d_O, p_O + \Delta = p_O$, then the resulting OER contract is equivalent to the Single-Price OER contract. QED.

4.3 Higher-Order OER Contracts
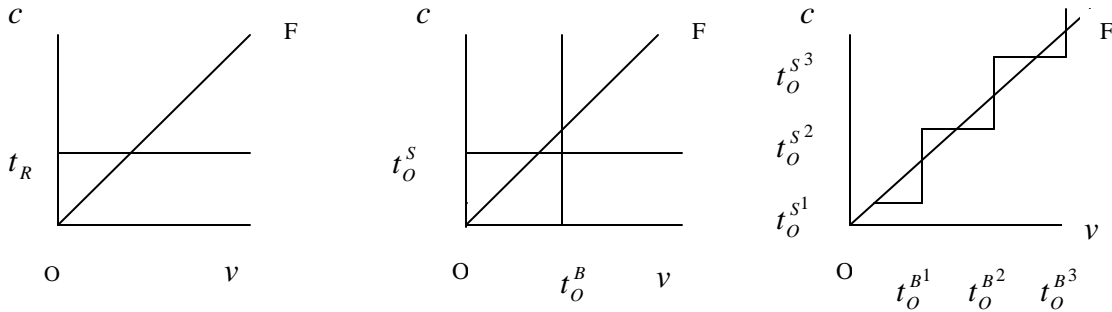
RLR Contract

OER Contract

Higher-Order OER Contract
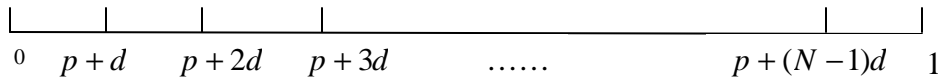
Figure 3a

Figure 3b

Figure 3c

Figure 3d

Figure 3 Higher-Order OER Contract

We have shown that with asymmetric information adding one more round of option-exercising in the contract can increase social welfare, because it effectively harnesses

both parties' private information, compared with only harnessing one party's private information under RLR. Following this logic, we can go further to add more rounds of successive options to improve efficiency. Indeed, it functions as a bargaining procedure, but it avoids many problems that bargaining will encounter with asymmetric information. We will use a simple example to show this.

We can see from Figure 3 a-c how OER contracts can lead to efficient results. The horizontal axis represents the Buyer's value, and the vertical axis represents the Seller's cost. The 45° degree line, OF, is the first best breach threshold; the Buyer and the Seller should breach northwest to the line OF, and should perform southeast to the line OF. RLR contracts only set a breach threshold, t_R, for the Seller, and the Seller will breach whenever his cost is above t_R, and perform whenever his cost if below t_R. First-order OER contracts set thresholds for both parties. Only in the area northwest to lines t_O^S and t_O^B does breach occur. As we can see from Figure 3c, if we further add more rounds of options, the diagram becomes more and more like a step function which approached the first best line OF.

Now we simplify our analysis of a higher-order OER contract by assuming that both parties' values are uniformly distributed on [0,1], and we further confine ourselves to analyzing a special contract which specifies successive thresholds as equal-distance incrementals, $p + d, p + 2d,......, p + (N-1)d$, until 1, where $d > 0$.
breach
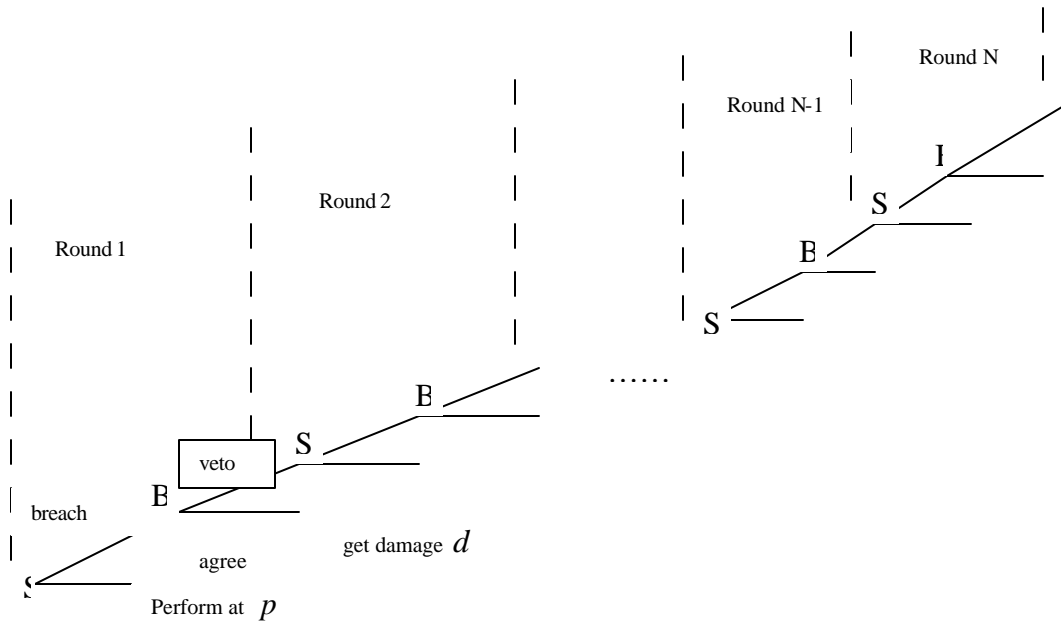
TO BE CONTINUED

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