Incomplete Contracts with Asymmetric Information: Exclusive Versus Optional Remedies

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Scholars have been debating for years the comparative advantage of damages and specific performance. Yet, most work has compared a single remedy contract to another single remedy contract. But contract law provides the non-breaching party with a variety of *optional* remedies to choose from in case of a breach, and parties themselves regularly write contracts which provide such options. In this article, we start filling this gap by studying multi-remedy contracts. Specifically, we compare a contract that grants the non-breaching party an option to choose between liquidated damages and specific performance with an exclusive remedy contract, which restricts the non-breaching party's remedy to liquidated damages only.

We are grateful for helpful comments from the anonymous referee, and Oren Bar-Gill, Bob Bennet, Omri Ben-Shahar, Richard Brooks, Albert Choi, Jim Dana, Johannes Horner, Morton Kamien, Avery Katz, Bentley MacLeod, Max Schanzenbach, Dick Speidel, Alan Schwartz, Steve Shavell, Kathryn Spier, Eric Talley, George Triantis, and participants of the annual meetings of American Law and Economics Association (Chicago, 2004), the Israeli Law and Economics Association (Jerusalem, 2004), the participants in the University of Virginia John M. Olin Conference "Real Options and the Law" (October 2004), the law-and-economics workshop in the University of Southern California (November, 2004), and seminar participants in Northwestern University, Georgia State University, and the Chinese University of Hong Kong. All remaining errors are our own responsibility.

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American Law and Economics Review
doi:10.1093/aler/ahl011
Advance Access publication July 28, 2006

1. Introduction

Law and economics scholars have always had a strong interest in contract remedies. Perhaps the most explored issue in contract law has been the desirability of various contract remedies, most commonly expectation damages, specific performance, or liquidated damages. Scholars have been debating for years, from various perspectives, the comparative advantage of these remedies.[1] Yet, most scholars have assumed that each of these remedies is *exclusive.* Interestingly, an analysis that assumes these remedies are *optional* (or *cumulative*) has not yet been explored, although contract law provides the non-breaching party with a variety of optional remedies to choose from in case of a breach[2] and although parties themselves write contracts which provide such an option.[3]

In this article, we attempt to start filling this gap by studying the *relationship* between these remedies. Specifically, we study the conditions at which a contract that grants the non-breaching party an option to choose from optional remedies is superior to an exclusive remedy contract. We show that, with two-sided uncertainty and asymmetric information between a seller and a buyer, the interaction of the parties' distributions determines whether a contract shall provide for exclusive or optional remedies. We show that neither the regime of exclusive liquidated damages nor the regime of optional liquidated damages is unconditionally Pareto superior. Rather, sometimes an exclusive regime would be welfare maximizing for the parties and sometimes an optional one would be. We thus suggest allowing the parties to agree in certain circumstances to let the non-breaching party choose the remedy after the breach when it has already learned new information, whereas in other circumstances to agree to restrict that option. In this way, parties decide ex ante which party, the buyer or the seller, would take advantage of the new information revealed before the time of performance.

1. See, for example, Ulen (1984) and Goetz and Scott (1977).

2. Chapter 7, Article 2, of the UCC provides a list of optional remedies, but parties can agree on any other remedy, provided they conform with some basic principles of contract law. See generally Article 1–102(3) to the UCC and more particularly see Article 2–719(1). The entire of chapter 66 in Corbin is dedicated to "election of remedies."

3. It is sufficient to recall the following prevalent contract clause: "Upon breach, the seller can choose, *at his discretion*...."

We find that parties would prefer a non-exclusive regime whenever $E(v|v \geq k_R^*) > E(c|c \geq k_R^*)$, where v and c are buyer's valuation and seller's cost, respectively, and $k_R^* \equiv p_R^* + d_R^* = E(v)$ is the "effective" damage award and is in fact the breach threshold under the exclusive regime (i.e., the seller would breach if his ex post costs are above k_R^*).[4] This means, in plain words, that if the buyer's conditional expected valuation is larger than the seller's conditional expected costs (in both cases, conditioned on their ex post valuation and costs being above the seller's breach threshold), then a contract that provides the buyer an option to choose between liquidated damages or specific performance is superior to a contract that provides for exclusive liquidated damages. The intuition is simple. Although allowing the seller to unilaterally breach and pay liquidated damages may lead sometimes to an efficient breach (when seller's ex post cost is not only higher than the liquidated damages but also higher than the buyer's ex post valuation), in other times it may lead to an inefficient breach (when seller's ex post cost is higher than the liquidated damages but lower than the buyer's ex post valuation). The condition states that, in the "battle" between a high-cost seller who prefers to breach and a high-value buyer who prefers performance, parties will agree to give the buyer the option to enforce if, from the ex ante perspective, his expected valuation in such state of the world is higher than the seller's expected cost.

Our analysis focuses on the ex ante design of the contract in light of the new information that the parties anticipate they will gain after they draft the contract. Also, we focus on simple fixed-term contract where no renegotiation or investments are involved.[5] We demonstrate the optimal way to design contract clauses, which take advantage of the information that the parties receive between the time they enter the contract and the time of actual breach. We further suggest that parties indeed use such clauses and that courts honor them.

Our analysis in this article informs transactional lawyers of the relevant economic factors they should consider when deciding the optimal

4. p_R^* and d_R^* are equilibrium price and liquidated damages, respectively, in the exclusive regime. See discussion in Section 4.

5. Indeed, in an environment of asymmetric information renegotiation costs are high. More on this below.

composition of remedies in a given context. Moreover, our analysis is relevant for courts that interpret "silent" or "ambiguous" contracts because it can help them to better understand whether rational parties would have agreed that a particular remedy be an exclusive remedy or an optional remedy.[6] Lastly, our analysis provides yet another economic rationale for why courts should enforce parties' liquidated damage clauses even if it seems ex post over- or under-compensatory.

After laying out the basic model, we provide a simple extension to it. An exclusive liquidated damage contract is equivalent to granting the seller a call option to breach and pay, where the exercise price is equal to the agreed amount of liquidated damages. A non-exclusive, or optional, contract, where the buyer can insist on performance, is equivalent to giving the buyer a consecutive call option with the same exercise price. Yet, the consecutive call option to the buyer must not necessarily have the same exercise price but can rather have a different one. We call this new contract a two-price contract and show that it is even more efficient than the basic contracts we have explored before.

In Section 2, we describe the legal background against which we have designed our model. In Section 3, we survey the literature that evaluates contract remedies from an economic perspective. In Section 4, we present a simple model with two-sided incomplete information and with a liquidated damage clause. We compare the performance of an optional remedy regime with an exclusive remedy regime and then determine the conditions under which each regime should be applied. In Section 5, we discuss some extensions to the basic model. In the appendix, we provide some details of the price and liquidated damages clause and collect the proofs.

2. The Law of Exclusiveness of Remedies

Although the typical default remedy for breach of contract is expectation damages, other remedies may also be available. For example, where the goods are unique and damages are otherwise inadequate, the default

6. By a "silent" contract, we mean a contract, which does not say whether the liquidated damages are the exclusive remedy of the non-breaching party. An "ambiguous" contract is a contract, which in one place implies that liquidated damages are the sole remedy of the non-breaching party, whereas in another place implies it is not.

remedy may be specific performance if enforcement does not impose too large of a burden on the court, and other conditions are met.[7]

Parties can expand or restrict the set of available remedies in case of a breach. They can agree, for example, on liquidated damages [see section 356 of the Restatement (Second) of Contracts and Article 2–718 to the UCC]. If the liquidated damage clause meets some necessary conditions, like not being a penalty or otherwise unconscionable, then courts may well enforce such clauses.

Parties can then further agree that the liquidated damages clause will or will not be the exclusive remedy. They can agree, for example, that the non-breaching party will be allowed, upon breach, to elect between receiving the pre-determined liquidated damages and seeking specific performance. Courts will most likely honor such clauses.[8] Alternatively, parties can agree that the liquidated damages be the exclusive remedy, and courts will honor it. For example, in a recent 2002 case, the Appellate Court of Illinois refused to grant the purchaser of a townhouse specific performance (which is traditionally considered the default remedy for breach of land contracts) only because the contract explicitly provided that the purchaser's liquidated damages are his "sole remedy" (*O'shield v. Lakeside Bank,* 2002).

A study of various standard industry contracts reveals that both types of contracts—where parties contract for exclusive or for optional liquidated damages—widely exist. For example, most standard real estate contracts state explicitly that in the event of breach, the seller's *exclusive* remedy is liquidated damages in the form of earnest money.[9] Similarly, in production contracts under which goods are specially manufactured for the buyer and are not readily resalable on the market, the buyer's *exclusive* remedy is liquidated damages.[10] The same holds in some contracts where

7. See article 2–716 to the UCC and Restatement (Second) of Contracts articles 359 and 366.

8. See, for example, *Underwood v. Sterner* (1963). For a more recent case, see *Sweatt v. International Development Corp*. (2000).

9. See, for example, Mississippi Real Estate Contracts and Closings, Contracts for the Purchase of Real Estate § 6:18. 10 Ariz. Legal Forms, Bus. Org. LLC & Part. § 27.4 (2d ed.). But sometimes they leave it open: 15C Am. Jur. Legal Forms 2d Real Estate Sales § 219:596.

10. See, for example, West Pennsylvania Forms, Buyer's Right on Improper Delivery § 2601. 4A Vernon's Okla. Forms 2d, Com. & Consumer Forms § 2–601—Form 2, 5 Ariz. Legal Forms, Comm. Transactions § 2.392 (2d ed.).

the amount of actual damages in the event of breach is not readily ascertainable.[11] Contracts for the sale of burglar or fire alarm systems are similar in that manner.[12] On the contrary, in a standard schools' invitations to bid for software[13] or in a standard 'Tree Estimate Timber Sale Contract', the liquidated damages are explicitly non-exclusive.[14] Other types of standard contracts where liquidated damages are not exclusive are contracts for purchasing a business[15] and agreements to transfer materials and intellectual property.[16]

Yet, exactly when parties would contract for exclusive liquidated damage clauses or for optional liquidated damage clauses is not clear. Below, we present a model that attempts to shed some light on this question.

Much litigation arises through liquidated damage contracts which do not explicitly mention whether the liquidated damages are exclusive or optional (we call them here "silent" contracts). Can the non-breaching party still seek specific performance?[17] In silent contracts, the general default rule is that the non-breaching party *is* entitled to seek specific performance, assuming the conditions for granting specific performance hold [Restatement (Second) of Contracts §357 (1979) and article 2–716 of the UCC].[18]

11. For example, one form contract recommends the following language: "It is agreed by and between the parties that the Contractor is not an insurer, that the payments hereinbefore named are based solely on the value of the service in the maintenance of the system described, that it is impracticable and extremely difficult to fix the actual damages, if any, which may proximately result from a failure on the part of the contractor to perform such service and in case of failure to perform such service and a resulting loss its liability hereunder shall be limited to and fixed at the sum of fifty dollars as liquidated damages, and not as a penalty, and this liability shall be exclusive." 27 West's Legal Forms, Specialized Forms § 3.9 (3d ed.).

12. 27 West's Legal Forms, Specialized Forms § 3.9 (3d ed.), 6 N.J. Forms Legal & Bus § 11A:14, 6A Texas Forms Legal & Bus. § 11C:68.

13. 30 West's Legal Forms, Specialized Forms § 31.46 (3d ed.), 15A Am. Jur. Legal Forms 2d Public Works and Contracts § 216:25.

14. 5E Nichols Cyc. Legal Forms s 5.6682.

15. 8 Nichols Cyc. Legal Forms s 8.1331.

16. Forms Legal & Bus. s 42:26.

17. Interestingly, the non-breaching party usually cannot seek actual damages in a silent contract. See Avraham and Liu (2006) for details.

18. The Restatement (Second) of Contract §361 (1979) reads "Specific performance or an injunction may be granted to enforce a duty even though there is a provision for liquidated damages for breach of that duty." This might strike the attentive reader as weird because one of the pre-conditions for granting specific performance is that damages are inadequate. But if parties agreed on liquidated

Yet, sometimes, courts interpret a silent liquidated damage clause as an exclusive remedy.[19] What exactly distinguishes these contracts from a silent contract which is interpreted by courts as a non-exclusive liquidated damages remedy is unclear.[20]

To sum up, the legal analysis has revealed that, first, parties explicitly contract for both exclusive and optional liquidated damage clauses; yet, it is not clear when they would prefer each type of clause. Second, when the liquidated damage clause is silent, courts usually allow the non-breaching party to seek specific performance; yet, sometimes they do not, without any apparent reason for what accounts for the difference in their interpretation of the contract.

This demonstrates the need for a model that shows exactly when parties would contract for exclusive liquidated damages and when, in contrast,

damages ex ante, how can they be inadequate ex post? Yet, courts have ruled that the mere existence of liquidated damages does not render damages adequate, and specific performance can still be granted. See, for example, *Carolina Cotton Growers Association v. Arnette* (1974) and *Washington Cranberry Growers' Ass'n v. Moore* (1921), where the court essentially granted specific performance against a cranberry farmer despite a liquidated damages clause. And See Corbin (1964) section 1213 and Farnsworth On Contract (2004) at 173.

19. Courts have done this by interpreting the contract as an "option contract" or "alternate performance contract" that allows the breaching party to pay liquidated damages and nullify the contract, thus preventing the non-breaching party from seeking specific performance. Courts have done this even where the contract was not phrased as an option contract, and even if the asset was land. See for example, *Davis v. Isenstein* (1913) and *Bank v. Lester* (1981). See Farnsworth *id* at p 181.

20. "To distinguish between liquidated damages and alternate performances requires angels to dance upon the heads of pins." Debora Threedy, "Liquidated and Limited Damages and The Revision of Article 2: An Opportunity to Rethink The U.C.C's treatment of Agreed Remedies," 27 *Idaho Law Review* (1990–1) 427, 441. And consider: "Because of its ambiguity, the alternative performances device has been a method frequently used by courts to enforce clauses that they believed they could not enforce as liquidation of damages provisions." Justin Sweet, "Liquidated Damages in California," 60 *California Law Review* (1972) 84, 94. And see Corbin *id* section 1213. "The fact that the contract provides that, in case of breach, the damage shall be as there admitted, does not of itself conclusively establish that the parties contemplated that, upon the breach thereof, damages would be an adequate remedy. It is a question of intention in each case, to be deduced from the whole instrument and the circumstances, and, if it appears that the performance of the covenant was intended, and not merely the payment of damages in case of breach, the contract will be enforced," *Washington Cranberry Growers' Ass'n v. Moore* (1921) 201 P. 773, at 777.

they would allow the non-breaching party to seek specific performance. Such a model will be useful for courts when they interpret "silent" contracts as well as for lawyers to avoid "silent" contracts and be explicit about whether the liquidated damage clause is exclusive. In Section 4, we present this model.

3. Related Literature

In this section, we discuss previous related work and distinguish our work. Avraham and Liu (2005) provides a more detailed survey. Current economics literature indicates that complex, contingent contracts that apply a mechanism design approach can achieve first best when parties write the contracts at ex ante stage. Yet, these contracts are hard to find in practice. Economists have explained the rarity of these contracts in that they are difficult to design, in that they are hard to enforce, and in that they are not robust to renegotiation (Harmelin and Katz, 1993; Rogerson, 1992; Tirole, 1986). They were also criticized for being susceptible to courts' errors (Zhang and Zhu, 2000).

In contrast, we explore simple fixed-term contracts. Economists showed that simple contracts may achieve first best only if parties' realized valuations are observable and costless renegotiation is possible. We, however, explore fixed-term contracts where parties' realized valuations are assumed to be *un*observable, which means that ex post renegotiation is much more costly; indeed, we assume that it is prohibitively costly.[21] We suggest that letting parties have the ex ante option to restrict or expand the non-breaching party ex post remedy selection

21. A quick note on the plausibility of our no-renegotiation assumption is nevertheless necessary here. First, one needs to compare the plausibility of this assumption to the plausibility of the opposite assumption that of costless renegotiation. Most articles that used fixed-term contracts required the assumption of costless renegotiation to be able to achieve the first-best outcome, an outcome, which the contingent-contract literature was able to achieve without assuming costless renegotiation. Yet, a renegotiation game is never costless expost and hard to design ex ante. It is thus questionable whether writing a fixed-term contract and designing a renegotiation game (which itself should be renegotiation proof) is indeed simpler than writing a contingent contract (Schmitz, 2001). It is therefore also questionable whether costless renegotiation is a more plausible assumption to make than the one we make here. Second, and more importantly, one should bear in mind that our information structure is less restrictive than many other articles

increases efficiency and might help explain why these simple contracts are so prevalent in practice even in situations where ex post parties face asymmetric information.

One can easily find in the literature analyses of fixed-price contracts, with or without damage clauses, for example, see Shavell (1980, 1984), Rogerson (1984), Aghion and Bolton (1989), Chung (1992), Spier and Whinston (1995), Edlin and Reichelstein (1996), Miceli (1997), Zhu (2000), and Zhang and Zhu (2000). These articles usually deal with one-sided uncertainty with or without accounting for possible renegotiation, and the realized valuations are observable at the interim stage. 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. Edlin (1998), Edlin and Schwartz (2003), and Shavell (2004) are excellent surveys. Our article is different from these articles in that the information is not observable but asymmetric at the interim stage,[22] and the parties face two-sided uncertainty.

Shavell's (2006) approach is similar to ours, exploring parties' preferences at contract formation. Specifically, he demonstrates that parties prefer damage awards in contracts to produce goods but prefer specific performance in contracts to convey property. Our results are not inconsistent with Shavell's analysis; however, our results address contracts

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 probably more costly than when parties' valuations are observable. Indeed, models, which account for renegotiation typically assume that parties' valuations at the trade-or-renegotiate stage are observable. Although making renegotiation less costly, the observability assumption (which we do not make) is quite restrictive (see Chung, 1992; Edlin and Reichelstein, 1996; Hart and Moore, 1988; Noldeke and Schmidt, 1995; Spier and Whinston, 1995). Third, some have argued that parties may find ways to commit to not renegotiate or at least find ways to significantly raise the costs of renegotiation. Maskin and Tirole (1999) analyze several ways parties can commit to not renegotiate (but see Hart and Moore, 1999). Thus, our model also captures situations where parties were able to commit to not renegotiate. As Hart and Moore (1999) recently noted the degree of the parties' ability to committing not to renegotiate "is something about which reasonable people can disagree." Therefore, they argue, both cases where parties can and cannot commit not to renegotiate are worthy of study. Lastly, even if renegotiation were simple, this article provides a benchmark for assessing the change because of renegotiation (Rogerson, 1992).

22. And accordingly we assumed no renegotiation.

containing two-sided uncertainty, whereas Shavell restricts his analysis to contracts containing uncertainty only for the seller.

Our article is also closely related to the legal literature on optional property/liability rules (Ayres and Balkin, 1996; Ayres and Goldbart, 2001, 2003; Avraham, 2004; Kaplow and Shavell, 1996; Knysh, Goldbart, and Ayres, 2004). But those articles focus on ex post determination of liabilities by the courts, whereas our article studies the ex ante contracting between private parties where the only role of the courts is to honor the contract if breach happens. See Avraham and Liu (2005) for details.

4. The Model

4.1. 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 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 the seller's cost of production because of future fluctuations in the market prices for the inputs for the materials the seller promised to deliver. Thus, it is assumed that seller's cost, c, is drawn from a density function $f(c)$ with cumulative distribution function denoted $F(c)$ in the interval $[\underline{c},\bar{c}]$. There is also uncertainty about buyer's valuation of the good because of 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 distribution function denoted $G(v)$ in the interval $[\underline{v},\bar{v}]$, where $G(\cdot)$ and $F(\cdot)$ are independent and common knowledge.[23] This two-sided 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 their own valuations. Table 1 summarizes the timeline.

At Time 1, the seller and the buyer are symmetrically uninformed about each other's as well as their own valuations. They enter a contract with a

23. Our basic results apply to the case of correlated distributions as well.

Table 1. Time Line for the Model with Liquidated Damages

1		2	3
Parties enter a contract	Parties learn new information	Seller delivers or breaches	Court decides and parties obey

price, p, and liquidated damages clause, d. Without loss of generality, and 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 makes a take-it-or-leave-it offer of both the price, p, and the amount of the liquidated damages, d.[24]

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 whether the liquidated damages are exclusive or whether the buyer can insist on specific performance.

In the interim period between Time 1 and Time 2, both parties learn their true valuations 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 valuations only after Time 1 is that new information, 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 he intends to manufacture was approved by some federal agency for distribution in the United States, and so forth.

At Time 2, the seller, after learning his exact cost of performance, decides whether to deliver the good or breach. In making his decision, the seller takes into account the price and liquidated damages agreed upon in Time 1 and whether the liquidated damages are exclusive. The buyer's valuation at this stage is still not observable to the seller (or verifiable to third parties). Instead, the seller continues to consider the buyer's valuation as a random variable.

24. Because parties contract at the ex ante stage and because we do not consider investment decision, our results remain the same for any allocation of bargaining power, $\theta \in [0, 1]$, between the parties.

At Time 3, the court observes if breach occurred but 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 Regular Legal Regime (RLR), in which the liquidated damages are exclusive so the seller pays damages that are equal to the liquidated damages, d_R. We call it RLR, because this is the legal regime the literature considers for liquidated damages. Second, an Option to Enforce Regime (OER), in which the liquidated damages are not exclusive so the buyer can insist on getting specific performance over receiving the liquidated damages, d_O.[25] If the buyer chooses to get the liquidated damages, the seller then pays the liquidated damages. Yet, if the buyer chooses specific performance, the seller must deliver. At Time 3, when the buyer makes his decisions, the seller's realized cost of performance is not observable to the buyer or verifiable to the court.[26]

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

4.2. Analysis

4.2.1. Regular Legal 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 and d_R is the liquidated damages under RLR. Price is payable upon performance. The seller will get $p_R - c$ if he performs, and ($-d_R$) if he breaches. Therefore, he will breach if $c > p_R + d_R$. We denote $k_R \equiv p_R + d_R$ where k_R is the breach threshold. The seller will therefore breach if $c > k_R$. If the contract is accepted by the seller, the

25. To keep this already long article somewhat shorter, we consider here only the option to enforce and do not consider buyer's option to recover actual damages. In a separate working paper, we consider that regime as well.

26. Parties in Time 1 only observe each other‘s distributions. In addition, the 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. Observe that our model is a sequential game. We believe that a sequential game more realistically captures real life situations.

buyer will get an expected payoff which is equal to

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

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 buyer's expected payoff when the seller decides to breach.

The seller's expected payoff (if he accepts the contract) is

$$\pi_R^S = F(k_R)[\, p_R - E(c|c \leq k_R)] + [1 - F(k_R)](-d_R).$$

The first term represents the seller's expected payoff if he performs, and the second term represents his expected payoff if he breaches.

By assumption, the buyer has the entire bargaining power and therefore can extract the entire ex ante surplus, which means that the seller's participation constraint is binding. Note however that ex post the seller might get some positive payoff because he possesses private information about his realized production cost.

The buyer will choose k_R to maximize the joint payoff, and then manipulate the price to guarantee the seller a zero expected payoff,

$$\underset{k_R}{Max}\, \pi_R^B + \pi_R^S = F(k_R)E(v) - \int_{\underline{c}}^{k_R} c dF(c).$$

The equilibrium is summarized in Lemma 1.

Lemma 1. Under RLR with exclusive liquidated damages, the equilibrium is

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

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

$$\pi_R^{S^*} = 0.$$

Remark. (a) It is a standard result that expectation damages (under RLR) induce an optimal level of breach with one-sided uncertainty, for example, see Shavell (1984). Observe that in our model however $d_R = E(v) - p_R$ means that the equilibrium liquidated damages equals the *expected* expectation damages.

(b) Observe that the breach threshold $k^*_R \equiv p^*_R + d^*_R$ is equal to the buyer's expected valuation, $E(v)$. Thus, from the ex ante perspective, the RLR induces an optimal level of breach: the seller would breach if his ex post costs is larger than the buyer's (expected) valuation. However, from the ex post perspective, the level of breach might not be optimal. The seller would breach whenever $c \geq E(v)$, yet, this would be inefficient in cases in which the buyer's ex post valuation is even higher, that is, when $v > c > E(v)$. Conversely, the seller delivers whenever $c < E(v)$, and this is inefficient in cases in which $v < c < E(v)$. Thus, under RLR we get both (ex post) inefficient performance and inefficient breach. As we will see below, under OER, we get (ex post) inefficient performance yet not inefficient breach.

4.2.2. Option to Enforce Regime. When the legal regime is OER (that is, when the liquidated damages are not exclusive so the buyer can insist, upon breach, on specific performance), the buyer offers the seller at Time 1 a take-it-or-leave-it contract (p_O, d_O), where p_O is the price and d_O is the liquidated damages under OER. Price is payable upon performance. As before, we denote the breach threshold $k_O \equiv p_O + d_O$. Obviously, the seller will attempt to breach if $c \geq k_O$; otherwise, he will perform. The buyer will insist on delivery if $v \geq k_O$ and will agree to receive liquidated damages otherwise.

If the seller accepts the contract, the buyer will get an expected payoff of

$$\pi^B_O = F(k_O)[E(v) - p_O] + [1 - F(k_O)]\{G(k_O)d_O + [1 - G(k_O)][E(v|v \geq k_O) - p_O]\}.$$

The first term on the right-hand side represents the buyer's expected payoff if the seller performs. The second term represents the buyer's expected payoff if the seller attempts to breach. The first term in the curly parentheses is buyer's payoff when the buyer agrees to receive liquidated damages, and the second term is the payoff when he insists on specific performance.

Similarly, the seller's expected payoff (if he accepts the contract) is

$$\pi_O^S = F(k_O)[\,p_O - E(c|c \le k_O)] \\ + [1 - F(k_O)]\{G(k_O)(-d_O) + [1 - G(k_O)][\,p_O - E(c|c \ge k_O)]\}.$$

The first term on the right-hand side represents the seller's expected payoff when he chooses to perform. The second term represents his expected payoff when he attempts to breach the contract. The first term in the curly parentheses is the payoff when the buyer agrees to receive liquidated damages, and the second term is the payoff when the buyer insists on specific performance.

As before, the buyer can choose k_O to maximize the joint payoff and then manipulate the price to guarantee the seller a zero expected payoff,

$$\underset{k_O}{Max}\ \pi_O^B + \pi_O^S = F(k_O)E(v) + [1 - F(k_O)]\int_{k_O}^{\bar{v}} v dG(v) \\ + G(k_O)\int_{k_O}^{\bar{c}} c dF(c) - E(c). \tag{1}$$

Denote $h(x) \equiv \frac{f(x)}{1-F(x)}, \kappa(x) \equiv \frac{g(x)}{G(x)}$ and $\lambda(x) \equiv \frac{h(x)}{h(x)+\kappa(x)}$.[27] We have the following Lemma 2.

Lemma 2. The joint expected equilibrium payoff under OER is

$$\pi_O^{B^*} = F(k_O^*)\left[E(v) - E(c|c \le k_O^*)\right] \\ + \left[1 - F(k_O^*)\right]\left[1 - G(k_O^*)\right]\left[E(v|v \ge k_O^*) - E(c|c \ge k_O^*)\right], \tag{2}$$

where k_O^* is the solution to

$$k_O^* = \lambda(k_O^*)E(v|v \le k_O^*) + \left[1 - \lambda(k_O^*)\right]E(c|c \ge k_O^*). \tag{3}$$

Proof. The first-order condition of the buyer's maximization problem (1) above is:

27. $h(x)$ is the hazard rate of c, that is, the probability of $c = x$ given that $c \ge x$. $\kappa(x)$ is the probability of $v = x$ given that $v \le x$; λ(x) measures the relative sizes of these two probabilities.

$$\left[\int_{\underline{v}}^{k_O} vdG(v) - k_O G(k_O)\right] f(k_O) + \left\{\int_{k_O}^{\bar{c}} cdF(c) - k_O[1 - F(k_O)]\right\} g(k_O) = 0. \tag{4}$$

Equation (3) follows from equation (4). QED.

Remark. (a) The intuition behind equation (2) is as follows. The first term represents the joint expected payoff when the seller performs. It is the probability that this state of the world materializes, multiplied by the difference between the buyer's and the seller's expected valuations in that state of the world. The second term represents the joint expected payoff when the seller attempts to breach but the buyer insists on performance. It is the probability that this state of the world materializes, multiplied by the difference between the buyer's and the seller's expected valuations in that state of the world. What is missing from equation (2) is the state of the world where the seller attempts to breach and the buyer agrees to receive the liquidated damages. But this is a pure transfer and therefore is not part of the joint-payoff maximizing problem.

(b) The intuition behind equation (3) is as follows. When setting the breach threshold, k_O, the buyer faces a tradeoff: increasing k_O (e.g., holding p_O constant, but increasing d_O) will increase the damages he receives from the seller in the event of breach; yet, the seller's probability of breach is reduced as a result of the higher damages he would have to pay in that event. Thus, the optimal breach threshold, k_O^*, is the weighted sum of the buyer's lower-than-the-threshold truncated expected value and the seller's higher-than-the-threshold truncated expected cost.

(c) Similar to the case under the RLR regime, the ex post level of performance under the OER regime might not be optimal. Although every breach is necessarily (ex post) efficient, not every performance is. The seller breaches whenever $c \geq k_O^*$ and $v \leq k_O^*$, which holds only if $c > v$, and is therefore efficient. However, the seller delivers in two situations. First, the seller delivers whenever his costs are high; yet, the buyer insists on performance because his valuation is also high, that is, whenever $c \geq k_O^*$ yet $v \geq k_O^*$. This is inefficient in cases in which the seller's costs are higher (notwithstanding the buyer's insistence), that is, whenever

$c \geq v \geq k_O^*$. Second, the seller delivers whenever his costs are low, that is, whenever $c \leq k_O^*$. This is inefficient in cases in which the buyer's valuation is even lower, that is, whenever $v \leq c \leq k_O^*$.

(d) *Uniform Distribution Example*: If c is uniformly distributed on $[\underline{c}, \bar{c}]$, and v is uniformly distributed on $[\underline{v}, \bar{v}]$, then we derive from equation (3): $k_O^* = (\bar{c} + \underline{v})/2$. The optimal breach threshold is the midpoint of the buyer's lower-bound and the seller's upper-bound values. It is the midpoint of the specific intersection of the parties' distributions in which the uncertainty whether the buyer's valuation or the seller's cost is greater exists (in all other regions, the choice is easy). Figure 1 represents it.

(e) Under which of the regimes, OER or RLR, do we get more breaches? One might have the intuition that more breaches occur under RLR because of the seller's unilateral option to breach and pay liquidated damages. This intuition is wrong however because it wrongfully assumes that the breach threshold under both regimes is identical. In fact, the buyer determines different breach thresholds. Of course, if $k_O^* \geq k_R^*$, then OER would necessarily yield less breaches. Yet, $k_O^* < k_R^*$ does not mean that RLR would yield less breaches, because although the breach threshold is lower under OER, and therefore the seller would be more likely to attempt to breach, under OER, the buyer might insist on performance.

(f) Can we determine under which regime the breach threshold is higher? Interestingly, depending on parties' distribution of valuations, the breach threshold under OER, k_O^*, can be larger or smaller than the breach threshold under RLR, k_R^*. Thus, depending on the initial distribution of parties' valuations, either regime may induce more breaches. Lemma 3 determines the conditions at which the threshold under OER will be smaller than the threshold under RLR.

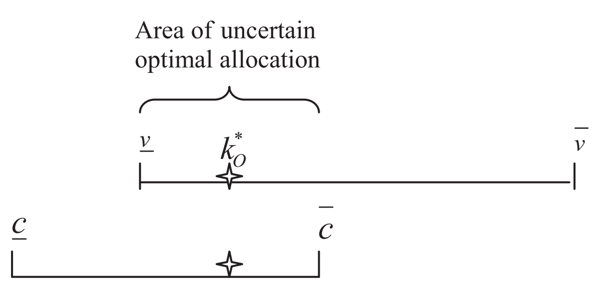

Figure 1. Optimal Breach Threshold with Uniform Distribution.

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 $k_O^* < k_R^*$.

Proof. See the appendix.

Remark. (a) Lemma 3 suggests that the relative size of two effects around the critical value determines whether k_O^* is above or below k_R^*. Recall from comment (c) to Lemma 2 that, under OER, there is no problem of inefficient breach but only of inefficient performance. Further recall that there are two situations of inefficient performance: one is when the seller's costs are high yet the buyer's valuation is lower (despite his insistence on performance), and the other is when the seller's costs are low yet the buyer's valuation is even lower. Unfortunately, the buyer cannot simultaneously eliminate both inefficiencies. To reduce the inefficiency loss in the first case, the buyer should offer a contract with a higher breach threshold to induce more ex post efficient insistence on performance (and consequently more efficient performance). To reduce the inefficiency loss in the second case, the buyer should offer a contract with a lower breach threshold to induce more ex post efficient breach. Lemma 3 strikes the balance between these two cases around the RLR breach threshold. If the second effect is larger, the buyer (contract designer) will have an incentive to lower the breach threshold below $E(v)$ to encourage the seller to breach more.

To further see this, suppose that under OER the buyer sets the breach threshold at exactly $E(v)$. The first effect is in force when the buyer's value is above but extremely close to $E(v)$, and the seller's cost of performance is above $E(v)$ (this happens with probability $g(E(v))[1 - F(E(v))]$. In this case, the seller wants to breach, but the buyer slightly prefers performance. The expected efficiency loss from performance in this case is seller's expected cost $[E(c|c \geq E(v))]$ minus the buyer's valuation, which is infinitely close to $E(v)$. The second effect occurs when the seller's cost is below but extremely close to $E(v)$ and the buyer's value of performance is below $E(v)$ (this happens with probability $f(E(v))G(E(v))$. In this case, the buyer wants the seller to breach but the seller slightly prefers performance. The expected efficiency loss from performance in this case is again seller's cost [almost equal to $E(v)$] minus the buyer's expected valuation $[E(v|v \leq E(v))]$. If the second effect is larger, the buyer (contract designer) will have an incentive to lower the breach threshold from $E(v)$ to encourage the seller to breach more.

(b) Notice that our result is different from Stole (1992). Stole showed that efficient liquidated damages under asymmetric information are always under-compensatory (and thus the penalty doctrine is justified). Yet, in our model, this result does not always hold. If the condition in Lemma 3 is not satisfied, we might have what would look from the ex ante perspective as over-compensatory damages.[28] The difference between our result and Stole's is because of the different informational structure in the models and the fact that we consider OER where the liquidated damages clause is not exclusive; a regime that Stole does not consider.

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

Proposition 1 summarizes.

Proposition 1. In an environment of two-sided uncertainty and private information, OER is Pareto superior to RLR, if $E(v|v \geq E(v)) > E(c|c \geq E(v))$.

Proof. See the Appendix.

Remark. (a) When the seller attempts to breach, OER dominates RLR if the buyer's expected valuation is greater than the seller's expected cost, so long as both values are higher than $E(v)$. Recall from Lemma 1 that $E(v)$ is the optimal breach threshold, k_R^*, under RLR. Indeed, under RLR whenever the seller's cost is higher than this threshold, he will breach the contract. The interesting question is then whether it is efficient to breach the contract. Proposition 1 states that OER Pareto dominates RLR whenever the buyer's conditional expected valuation above the RLR breach threshold is higher than the seller's conditional expected cost above that threshold. Indeed, when that inequality holds, from ex ante perspective, performance is more likely to be efficient than breach. The reason lies in the fact that the buyer is likely to value the good at more than the seller's cost. Under these circumstances, shifting from RLR to OER, and thus providing the buyer with the option to enforce, is efficiency enhancing.

28. Notice that from ex ante perspective the "effective"compensatory damage would be $E(v)$, which is equal to κ_R^*. One explanation of over-compensatory damages is that the parties use it to strategically extract rent from potential third parties such as later entrants, see Edlin and Schwartz (2003) for a concise summary of the literature. Here even without consideration of the effect to third parties, from the ex ante perspective we might still see over-compensatory damages.

(b) 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 contract, (p_R, d_R), where the liquidated damages is the buyer's exclusive remedy, or an OER-like contract, (p_O, d_O), where the buyer has the option to insist on performance. The seller is indifferent as by assumption his expected payoff is always zero. Because the buyer can observe both distributions in Time 1, he will prefer the (p_O, d_O) contract whenever the condition stated in Proposition 1 is met; otherwise, he might prefer the (p_R, d_R) contract. The buyer's choice of contracts renders this regime to be *always* Pareto superior to the individual RLR or OER regimes. Proposition 2 summarizes.

Proposition 2. In an environment of double-sided uncertainty and asymmetric information, if specific performance and liquidated damage clauses are honored, allowing parties to choose the legal regime (RLR or OER) is Pareto superior to RLR and OER.

4.3. A Numerical Example

When parties' valuations are normally distributed, analytically solving the model for the contracts p_O, d_O and p_R, d_R is difficult. 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 (SD) of 2.5. Second, we assumed that the seller's costs are normally distributed with a relatively low mean and SD. Without loss of generality, we assumed the seller's mean equals 14.5 and the SD = 1.2. Third, we calculated the pairs (p_O, d_O) and (p_R, d_R) as well as the joint payoff for both the OER and the RLR contracts. Then, we plotted the *ratio* between the joint payoffs. Fourth, we increased the uncertainty about the seller's valuation (as represented by the SD) by 0.2 and performed the above routine again. We continued performing these four steps until the SD = 4.4. 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 SD) from an SD of 1.2 (which is much lower than the buyer' standard valuation) to a much larger SD of 4.4.

The fifth and last step was to increase the seller's mean by 0.5 and do all the above steps again, until the mean reaches 20. Thus, in effect, we calculated the ratio of 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 14.5 and 20 and standard variation between 1.2 and 4.4. Observe that we allow for the seller's mean to be higher than the buyer's mean. Parties may nevertheless contract in such cases because of seller's option to breach. Figure 2 represents our results.

The *Z*-axis in Figure 2 represents the ratio of the joint payoffs under OER and RLR. The middle of the *Z*-axis is the 1:1 point where both regimes yield the same joint payoff. The *X*-axis represents the seller's possible SDs (which runs from 1.2 to 4.4), whereas the *Y*-axis represents his possible means (which runs from 14.5 to 20).

Figure 2 shows that when the seller's expected costs is relatively low, both regimes yield roughly the same joint payoff, despite the relative difference between the parties' SDs. The intuition behind this result is that when the seller's ex post costs are relatively low, he will always perform. Thus, the joint payoff under either regime is about the same.

Figure 2 also shows a peak at the upper left side and a valley at the upper right side of the graph. Starting with the valley, Figure 2 shows that the larger the seller's expected costs and SD of the costs become, the more efficient RLR becomes relative to OER. The intuition is that when the

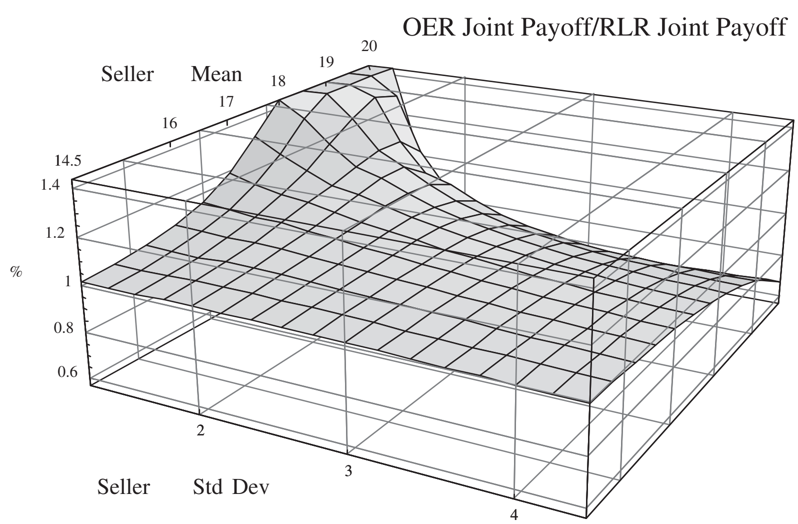

Figure 2. A Comparison of the Legal Regimes.

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 ex post costs will exceed the buyer's ex post valuation. Thus, 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 peak at the upper left side, Figure 2 shows that when the seller's expected costs are large yet his SD of these costs is small, OER becomes better relative to RLR. The intuition is that when parties' means are close to each other and there is not much uncertainty about the seller's ex post cost of production, then there is a higher probability that the buyer's ex post valuation will exceed the seller's ex post costs. In those cases, a rule that grants the buyer an option to enforce will be more efficient. Indeed, this is exactly what OER does.

Interestingly, as mentioned above, parties will sign a contract even when the seller's expected costs are higher than the buyer's expected valuation. The reason is that there is still a chance that the seller's ex post costs will be lower than the buyer's ex post valuation; so, the contract can be ex post efficient. Observe that indeed when the seller's expected costs are higher than the buyer's expected valuations of 18.5, RLR becomes better even for low seller SD.[29] The reason is that even with a relatively low SD the seller's ex post costs are more likely to exceed buyer's ex post valuation, and therefore, letting the seller breach and pay is superior to letting the buyer insist on performance; this is what RLR does. In other words, when his expected costs are higher than the buyer's expected valuation, the seller will be more likely to accept the contract under RLR because he knows that he could not be enforced to perform if his ex post costs will end up being high.

Our numerical model enables us to take a closer look at the specific price and damage clauses that the parties will agree on. Consider first the different prices that OER and RLR contracts will have. A buyer's subsequent option to enforce makes the seller worse off under the same price and damage term because he loses the power to unilaterally breach. Thus, one would expect that the buyer will "compensate" the seller for the switch from an RLR contract to an OER contract, by offering a higher price or by allowing the seller to pay lower liquidated damages in case of a breach, or any combination of the two. Indeed, our numerical analysis confirms

29. It is a little bit hard to see, but in the upper left corner of the three-dimensional graph, there is a deep valley.

this intuition. The buyer will “bribe” the seller to switch from the RLR to OER contract, with a higher price, lower damages, or both. Figure 4a and b in the appendix represents the results.

4.4. The Two-Price OER Contract

So far, to highlight the role of the option to enforce, we have assumed that, in the OER contract, if the buyer insists on performance, he could get performance and still pay the original price, p_O. We now relax this restriction in the OER. In this section, we consider the possibility that the OER contract will stipulate two different prices for the two scenarios of performance (Figure 3). The first price is for the state of the world where the seller voluntarily performs. The other price is for the cases where the seller involuntarily performs, that is, when the buyer insists on performance. To capture this insight, we add an additional variable, Δ, which represents the additional price the buyer needs to pay in the case he insists on performance. Thus, the buyer offers the following contract to the seller: (p_O, $p_O + \Delta$, d_O). The first term represents the price for voluntary performance, the second term is the price when the buyer insists on performance after the seller attempted to breach, and third term is the amount of liquidated damages that the seller agreed to pay in case of a breach when the buyer does not insist on performance. The game tree is in Figure 3 (the left term in brackets represents the seller’s payoff and the right term the buyer’s payoff).

Does a two-price OER contract yield a higher joint payoff than a single-price OER contract? One might have the intuition that if the seller knows that he may receive a higher price if he breaches, he would strategically over-breach, in the hope of getting that higher price. Under this intuition, a two-price OER contract might be inferior to a single-price OER contract because it leads to inefficient strategic behavior. Yet, this conclusion

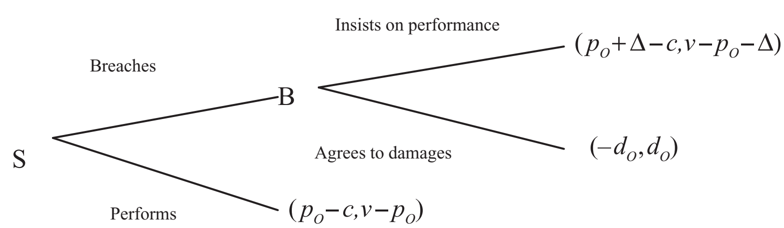

Figure 3. Option-to-Enforce Game with Two-Price Contract.

would be wrong. As proposition 3 shows, a two-price contract is superior to a single-price contract.

Proposition 3. A legal regime which enforces a two-price OER contract is always Pareto superior to a (single-price) OER and to RLR and therefore is superior to a regime which allows parties to decide whether they want their contract to be subject to OER or RLR, as was explained in Proposition 2.

Proof. A single-price contract is equivalent to a two-price contract where Δ is equal to zero. But because the buyer is free to choose$\Delta \neq 0$ as is the case in a two-price OER contract, the joint payoff would be (at least weakly) higher under a two-price OER than under a single-price OER. Similarly, a two-price OER contract is equivalent to the optimal RLR contract where $p_O = p_R^*, d_O = d_R^*, p_O + \Delta = \bar{v}$. But because the buyer is free to choose other values for (p_O, d_O, Δ), the joint payoff would be higher under a two-price OER than under RLR. As the legal regime which enforces a two-price contract is superior to both a legal regime which enforces a contract with exclusive liquidated damages and a legal regime which enforces non-exclusive damages, it must be also superior to a legal regime which allows the parties to choose between the two. QED.

Remarks. (a) The appendix provides a complete mathematical treatment for solving the parameters in the optimal two-price contract.

(b) The intuition for the first part is that the buyer who makes a take-it-or-leave-it offer knows that the seller would behave strategically in the hope of getting a higher payment in case the buyer insists on performance, but the buyer can always choose a $\Delta = 0$ to prevent it. If he chooses a $\Delta > 0$ in equilibrium, it must yield him a higher expected payoff. Because the seller's expected payoff is equal to 0, a higher expected payoff for the buyer entails a higher joint expected payoff.

(c) The intuition for the second part is that the buyer can always make in his take-it-or-leave-it contract the following choices: $p_O = p_R^*, d_O = d_R^*, p_O + \Delta = \bar{v}$. This first two terms mean that the buyer chooses a price and liquidated damage clause for the OER contract that are equal to the price and liquidated damage clauses he would have chosen in the RLR contract. The third term means that the "second price" he would have to pay if he insists on performance is equal to his upper-bound valuation, which means he would never exercise this option. The resulting OER contract is equivalent to the optimal RLR contract. But these choices do not necessarily yield the optimal two-price OER contract. Therefore, because the buyer may improve the contract by making different choices, the two-price OER regime is always ex ante Pareto superior to RLR.

(d) An RLR contract partitions the seller's information space using the breach threshold, k_R^* (in Time 2, he knows where his realized cost is located in the interval $[\underline{c}, \bar{c}]$). When his realized cost is in $[\underline{c}, k_R^*]$, the seller voluntarily performs; when the realized cost is in $[k_R^*, \bar{c}]$, he breaches the contract and pays damages. The buyer's information space is not partitioned at all under RLR. A single-price OER contract partitions both the buyer's and the seller's information spaces using a single threshold value, k_O^*. When his realized cost is in $[\underline{c}, k_O^*]$, the seller voluntarily performs; when the cost falls in $(k_O^*, \bar{c}]$, he attempts to breach. At that point, when the buyer's realized valuation is in $[\underline{v}, k_O^*]$, he agrees to get the liquidated damages; when the valuation falls in $(k_O^*, \bar{v}]$, he insists on performance. The two-price OER contract further refines the partition of both parties' information spaces. It partitions the parties' information spaces using two different optimal threshold values and hence can further reduce the area of the ex post inefficient regions.

(e) One may wonder whether parties can do even better by designing a more general *n*-round sequential options contract. For instance, after the buyer insisting on performance, under OER, the seller might be given an option to insist on breach, but only if he agrees to pay higher damages. Then in the next round, the buyer could insist on performance again, but only if he agrees to pay a higher price and so on and so forth. As we show in Avraham and Liu (2005), such a fixed-term sequential option contract can approach first best.

5. Summary and Future Research

In this article, we showed that, with two-sided uncertainty and ex post asymmetric information, parties can still do better through simple fixed-term contracts than was previously thought. We showed that neither of the regimes of exclusive liquidated damages or optional liquidated damages is superior. Rather, sometimes one regime would be welfare maximizing for the parties and sometimes the other. We thus suggested allowing the parties to agree, in certain circumstances, to postpone the choice of remedy by the non-breaching party until it has already learned the new information, while in other circumstances allowing them to agree to restrict that option. In this way, the parties determine ex ante whether the choice of remedy could be determined ex post; and parties decide ex ante which party, the buyer or the seller, would take advantage of the new information revealed by the time of future performance.

We restricted our attention to seller's breach. We found that parties would prefer a non-exclusive regime whenever $E(v|v \geq E(v)) > E(c|c \geq E(v))$. The intuition is that in the "battle" between a high costs seller who prefers to breach and a high value buyer who prefers performance, parties will agree to give the buyer the option to enforce, if from the ex ante perspective, his expected valuation in such state of the world would be higher than the seller's expected costs. It is straightforward to show that in the symmetric case of buyer's breach, a non-exclusive liquidated regime would be preferable by the parties whenever $E(v|v \leq E(c)) > E(c|c \leq E(c))$. The intuition is similar.

This analysis can not only help lawyers design contracts but also help courts interpret ambiguous or silent contracts because it allows them to objectively estimate what rational parties would have agreed to based on the business and economic circumstances that surrounded the agreement formation.

A regime which allows the parties to agree, if they wish, to give the buyer the option to enforce the contract (OER) or alternatively that restricts this option (RLR) is superior to both of these individual regimes. Thus, from a doctrinal perspective, our analysis indicates that courts should enforce parties' contracts, whether the liquidated damages clause is *exclusive* or *optional* to other remedies such as specific performance. Thus, to the extent that the current law restricts such options, it should be modified. Moreover, we believe that the proposed contract clauses will likely be enforced by courts, especially if the new proposed changes in the UCC will be accepted because the new proposed UCC is more liberal in enforcing liquidated damages clauses and specific performance clauses than the current UCC.

We extended our model to a two-price OER regime, where if the buyer insists on performance, he has to add to the original price a pre-determined amount. We showed that such a regime is always Pareto superior to both RLR and OER and therefore to a legal regime which allows the parties to choose between them. Thus, another policy implication which arises is for parties to write such contracts and for courts to enforce them. Despite its superiority, the two-price contract does not achieve first best. In Avraham and Liu (2005), we show that a legal regime with multiple rounds of sequential options can approach first best even in the environment of double-sided uncertainty and asymmetric information. Of course, such a regime is no longer simple to implement.

In our model, parties are not required to make investments; so, the desirability of signing a contract at the ex ante stage seems questionable. One may wonder whether parties would be better off waiting until they learn their valuations and then sign a contract when more information is on the table.[30]

The reason that parties bother writing a contract at the ex ante stage (even 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 causes inefficiencies because of parties' strategic behavior. In Avraham and Liu (2005), we show that the *optimal* contract designed in the interim stage is not necessarily more efficient than even a simple fixed-term contract designed in the ex ante stage.[31] 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. In Avraham and Liu

30. We thank Omri Ben-Shahar for bringing this issue to our attention.

31. Consider an example with uniform distributions: If the buyer's valuation and the seller's cost are both uniformly distributed on the interval [0,1], the optimal interim trading mechanism—the Myerson and Satterthwaite (1983) mechanism—yields an expected payoff of 9/64, whereas our two-price OER contract gives us a larger expected payoff of 4/27. This example shows that even a simple fixed-term ex ante contract could outperform the optimal interim contingent contract. For more details, see Avraham and Liu (2005).

(2005), we show the conditions at which the simple fixed-term ex ante contract is superior to the optimal interim contract.

Lastly, our analysis shows that once non-exclusive liquidated damages are considered, parties might agree on what would look from the ex ante perspective as super-compensatory damages. This has implications for the penalty doctrine.

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 renegotiation between the seller and the buyer. Third, one can study optimal investment decisions, given our information structure, or any other. Following Che and Hausch (1999) and Che and Chung (1999), we believe that both selfish investments and cooperative investments are worth exploring. Fourth, it will be interesting to follow-up on the literature, which accounts for third-party entrants. Chung (1992), Spier and Whinston (1995), and Hua (2003) have a useful analysis yet in a different information structure.

Lastly, the most direct extension of our model is to add additional remedies, such as actual damages, to our analysis. In Avraham and Liu (2006), we compare a contract which allows for expectation damages or specific performance as its single remedy with a contract which grants the non-breaching party the post-breach option to choose between the two remedies. We assume that the non-breaching party's expectation interest is unobservable to the court and that the parties try to therefore mislead the court about the expectation interest.

Appendix

General

The appendix collects the proofs of Lemmas 1 and 3 and Proposition 1, then compares the equilibrium prices and damages under different regimes using numerical simulation, and finally solves for the optimal two-price OER contract parameters.

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

Assumption A1. $[1 - F(x)]/f(x)$and $g(x)/G(x)$are decreasing in x.

Subscripts $O(R)$ denote values under OER (RLR), whereas superscripts B (S) denote values for the buyer (seller).

Proof of Lemma 1

Lemma 1. Under RLR with exclusive liquidated damages, the equilibrium is

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

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

$$\pi_R^{S^*} = 0.$$

Proof. We denote $k_R \equiv p_R + d_R$ where k_R is the breach threshold under RLR.

The buyer's expected payoff is

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

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

$$\pi_R^S = F(k_R)[\, p_R - E(c|c \leq k_R)] + [1 - F(k_R)](-d_R).$$

The buyer will choose k_R to maximize the joint payoff and then manipulate the price to guarantee the seller a zero expected payoff,

$$\underset{k_R}{Max}\ \pi_R^B + \pi_R^S = F(k_R)E(v) - \int_{\underline{c}}^{k_R} cdF(c).$$

The first-order condition (taking derivative with respect to k_R) is $f(k_R^*)E(v) - k_R^* f(k_R^*) = 0$, which implies that $k_R^* = E(v)$.

After solving the optimal breach threshold k_R^*, the buyer will solve for the price that ensures the seller will accept the contract. Substituting k_R^* with $E(v)$ into the seller's payoff function, we get

$$\begin{aligned}\pi_R^{S*} &= F(E(v))\left[p_R^* - E(c|c \le E(v))\right] + [1 - F(E(v))](-d_R^*)\\ &= F(E(v))\left[p_R^* - E(c|c \le E(v))\right] + [1 - F(E(v))](p_R^* - E(v))\\ &\qquad (\textit{substituting} \;\; d_R^* = k_R^* - p_R^* = E(v) - p_R^*)\\ &= p_R^* - \int_{\underline{c}}^{E(v)} c\,dF(c) - [1 - F(E(v))]E(v)\\ &= p_R^* - E(v) + \int_{\underline{c}}^{E(v)} F(c)dc \quad \text{(using integration by parts).}\end{aligned}$$

Let $\pi_R^{S^*} = 0$, we have $p_R^* = E(v) - \int_{\underline{c}}^{E(v)} F(c)dc$. Hence

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

The buyer's equilibrium expected payoff is

$$\begin{aligned}\pi_R^{B^*} &= F(k_R^*)[E(v) - p_R^*] + [1 - F(k_R^*)]d_R^*\\ &= F(k_R^*)[p_R^* + d_R^* - p_R^*] + [1 - F(k_R^*)]d_R^*\\ &= d_R^*.\end{aligned}$$

QED.

Proof of Lemma 3

Lemma 3. If

$$\begin{aligned}&g(E(v))[1 - F(E(v))][E(c|c \ge E(v)) - E(v)]\\ &\quad < f\,(E(v))G(E(v))[E(v) - E(v|v \le E(v))],\end{aligned}$$

then $k_O^* < k_R^*$.

Proof. The first-order condition (4) can be rewritten as

$$\Gamma(k_O^*) = -f(k_O^*)G(k_O^*)\left[k_O^* - \int_{\underline{v}}^{k_O^*} vdG(v)/G(k_O^*)\right]$$
$$+ g(k_O^*)[1-F(k_O^*)]\left\{\int_{k_O^*}^{\bar{c}} cdF(c)/[1-F(k_O^*)] - k_O^*\right\}$$
$$= g(k_O^*)[1-F(k_O^*)][E(c|c \geq k_O^*) - k_O^*]$$
$$-f(k_O^*)G(k_O^*)[k_O^* - E(v|v \leq k_O^*)] = 0.$$

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 $k_O^* < E(v) = k_R^*$ QED.

Proof of Proposition 1

Proposition 1. In an environment of double-sided uncertainty and asymmetric information, OER is Pareto superior to RLR, if $E(v|v \geq E(v)) > E(c|c \geq E(v))$.

Proof. We first prove for the case of the seller initiating breach. Let $k_o = E(v),\ p_O = x$, then the seller's expected payoff is

$$\pi_O^S\big|_{k_O=E(v),\ p_O=x} = [1 - G(E(v)) + F(E(v))G(E(v))]x$$
$$-[1-F(E(v))]G(E(v))[E(v)-x] - E(c) + G(E(v))\int_{E(v)}^{\bar{c}} cdF(c)$$
$$= p_O - E(c) + G(E(v))\int_{E(v)}^{\bar{c}} cdF(c) - [1-F(E(v))]G(E(v))E(v).$$

Let $\pi_O^S = 0$, we have $p_O = E(c) - G(E(v)) \int_{E(v)}^{\bar{c}} cdF(c) + [1-F(E(v))]$ $G(E(v))E(v)$. Because this price plus $d_O = E(v) - p_O$ guarantees the seller's expected payoff is 0, it is a feasible contract. Plugging this specific contract into the buyer's payoff function and simplifying, we get

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

and we have

$$\pi_O^B\Big|_{p_O=E(c)-G(E(v))\int_{E(v)}^{\bar{c}} cdF(c)+[1-F(E(v))]G(E(v))E(v),d_O=E(v)-p_O}-\pi_R^{B^*}$$
$$=F(E(v))E(v)+[1-F(E(v))]\int_{E(v)}^{\bar{v}} vdG(v)-E(c)+G(E(v))\int_{E(v)}^{\bar{c}} cdF(c)$$
$$-F(E(v))E(v)+\int_{\underline{c}}^{E(v)} cdF(c)$$
$$=[1-F(E(v))]\int_{E(v)}^{\bar{v}} vdG(v)-[1-G(E(v))]\int_{E(v)}^{\bar{c}} cdF(c)$$
$$=[1-F(E(v))][1-G(E(v))][E(v|v\geq E(v))-E(c|c\geq E(v))]$$
$$>0\quad \text{if the inequality in the proposition holds.}$$

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

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

$$\pi_O^{B^*}-\pi_R^{B^*}\geq\pi_O^B\Big|_{p_O=E(c)-G(E(v))\int_{E(v)}^{\bar{c}} cdF(c)+[1-F(E(v))]G(E(v))E(v),d_O=E(v)-p_O}-\pi_R^{B^*}>0,$$

if $E(v|v\geq E(v))>E(c|c\geq E(v))$.

The conditions for the buyer-breach case can be proved similarly. QED

Comparison of the Equilibrium Prices and Damages in Two Contracts

Our numerical model enables us to take a closer look at the specific price and damage clauses that the parties will agree on. As suggested in the text, one would expect that the buyer will "compensate" the seller for the switch from an RLR to an OER by offering a higher price or by allowing the seller to pay lower damages in case of a breach, or by any combination of the two. Indeed, our numerical analysis confirms this intuition. Figure 4a and b represents the results.

Figure 4a shows that, in general, the OER contract price is higher, except for a very small area where the seller's SD is extremely small and his expected costs are relatively large. Figure 4b shows that, in general, the damages in the OER contract are smaller, except for a very small area where both seller's SD and expected costs are very large. Thus, for every possible iteration of the seller's costs and the buyer's valuation, the OER contract provides the seller with a higher price, or lower damages, or both.

Solving for the Optimal Two-Price Contract

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 accept liquidated damages otherwise. If the seller performs, he will receive 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 $c \leq p_O + d_O + \Delta - [\Delta/G(p_O + d_O + \Delta)]$ and will attempt to breach otherwise.

We denote the seller's breach threshold as $p_O + d_O + \Delta - [\Delta/G(p_O + d_O + \Delta)] \equiv k_1$ and the buyer's threshold as $p_O + d_O + \Delta \equiv k_2$. Viewing the sequential option exercising as an internal, ascending auction process, we can see from the expression of k_1 that the seller will strategically overbid [with a term of $\Delta/G(p_O + d_O + \Delta)$] in the first round, trying to receive a higher price from the buyer in the next round. The buyer's expected payoffs is

$$\pi_O^B = F(k_1)[E(v) - p_O] + [1 - F(k_1)] \times \{G(k_2)d_O + [1 - G(k_2)][E_O(v|v \geq k_2) - p_O - \Delta]\}.$$

The seller's expected payoffs is

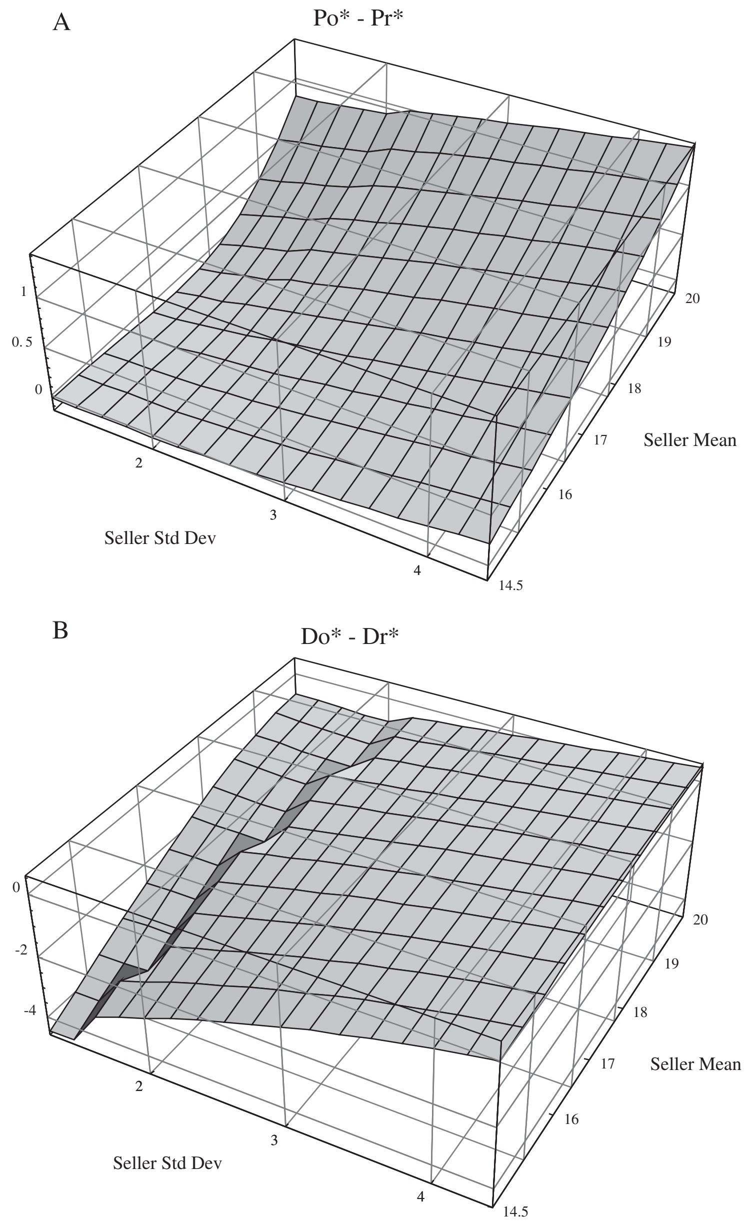

Figure 4. (a) A Comparison of the Contract Price. (b) A Comparison of the Contract Damages.

$$\pi_O^S = F(k_1)[\,p_O - E(c|c \le k_1)] + [1 - F(k_1)] \\ \times \{G(k_2)(-d_O) + [1 - G(k_2)][\,p_O + \Delta - E(c|c \ge k_1)]\}.$$

As before, the buyer will maximize the joint payoff, then manipulate to extract all surplus from the seller. The buyer's problem is

$$\underset{\{p_O, d_O, \Delta\}}{Max}\ \pi_O^B + \pi_O^S = F(k_1)E(v) - E(c) + [1 - F(k_1)] \int_{k_2}^{\bar{v}} v dG(v) \\ + G(k_2) \int_{k_1}^{\bar{v}} c dF(c).$$

The first-order conditions are as follows:

For p_O or d_O,

$$f\,(k_1)[1 + \Delta g(k_2)/G^2(k_2)] \left[\int_{\underline{v}}^{k_2} v dG(v) - k_1 G(k_2) \right] \\ + g(k_2) \left\{ \int_{k_1}^{\bar{c}} c dF(c) - k_2[1 - F(k_1)] \right\} = 0. \tag{5}$$

For Δ,

$$f(k_1) \left[1 - \frac{1}{G(k_2)} + \Delta g(k_2)/G^2(k_2) \right] \left[\int_{\underline{v}}^{k_2} v dG(v) - k_1 G(k_2) \right] \\ + g(k_2) \left\{ \int_{k_1}^{\bar{c}} c dF(c) - k_2[1 - F(k_1)] \right\} = 0. \tag{6}$$

Subtracting equation (6) from (5) gives us

$$\Delta = \int_{\underline{v}}^{k_2} G(v) dv. \tag{7}$$

It is easy to verify that $p_O^* + d_O^* + \Delta^* > \underline{v}$.[32] Equation (7) implies that $\Delta > 0$, which means that the buyer will never choose the single-price contract, despite the seller's strategic behavior.

Equations (6) and (7) imply

$$k_2 = E(c|c \geq k_1) = E\left(c \middle| c \geq k_2 - \frac{\Delta}{G(k_2)}\right). \quad (8)$$

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

$$\pi_O^S = p_O - E(c) + [1 - F(k_1)][\Delta - k_2 G(k_2)] + G(k_2) \int_{k_1}^{\bar{c}} c dF(c) = 0. \quad (9)$$

From equations (7)–(9), we can solve for p_O^*, d_O^*, and Δ^*.

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5 Ariz. Legal Forms, Comm. Transactions § 2.392 (2d ed.).

5E Nichols Cyc. Legal Forms s 5.6682.

6 N.J. Forms Legal & Bus § 11A:14.

6A Texas Forms Legal & Bus. § 11C:68.

8 Nichols Cyc. Legal Forms s 8.1331.

10 Ariz. Legal Forms, Bus. Org. LLC & Part. § 27.4 (2d ed.).

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15C Am. Jur. Legal Forms 2d Real Estate Sales § 219:596.

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32. If $p_o^* + d_o^* + \Delta^* \leq \underline{v}$, then the buyer will always insist on performance, and the two-price Option-to-Enforce contract is equivalent to a regime of specific performance, which is a regime that ignores parties' private information. This regime is less efficient than RLR (or OER) which do take advantage of the parties' private information. However, we can simply construct a feasible two-price Option-to-Enforce contract that is equivalent to an RLR contract—$p_O = p_R, d_O = d_R, p_O + \Delta = \bar{v}$. Therefore, $p_o^* + d_o^* + \Delta^* > \underline{v}$.

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