Whither Contract Damages: Contracts with Bilateral Reliance, One-sided Private Information*

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Abstract

This article explores the canonical contracting problem in a general set up of bilateral "selfish" reliance with post contractual one-sided asymmetric information, helping uncover the shape optimal contracts and the optimal damage remedies. The quantity choice of the traded commodity is initially binary, but later extended to a continuous case. Reliance by agents enhances individual valuations but is not contractible. If information concerning either valuation or cost accrues to one of the two contracting parties and remains private – neither observable to the other party nor even verifiable by court, dispute may arise in some state of the world and one party could contemplate anticipatory breach. This article categorically shows that in an asymmetric information scenario, a simple incomplete contract under a regime of court-imposed remedies, often fails to provide the right reliance incentive to both parties simultaneously. Additionally, a renegotiation does not help restore *ex post* efficiency, contrary to what happens in a symmetric information case. When the breach victim's expectation interest is difficult to be determined by court, a direct revelation mechanism can solve the problem of moral hazard, but assessing expectation damages correctly turns out to be at odds with *ex post* efficiency, an issue that is also explored. We conclude that a party designed liquidated damage measure is unconditionally superior to all other court imposed damage remedies.

Key Words author: Contract Law, Contract Breach, Incomplete Contracts, Moral Hazards, Mechanism Design.

Key Words plus: Contract Law, Damages, Asymmetric Information.

JEL Classification: D82, D86, K12.

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Los daños y perjuicios de origen contractual: nuevas perspectivas con respecto a contratos bilaterales con asimetría de información

Resumen

Este artículo explora los interrogantes económicos de la contratación al establecerse acuerdos bilaterales con información asimétrica unilateral *post* contractual, cuestión que ayuda a formular un modelo de contratación y de reparación de daños y perjuicios óptima. La cantidad elegida de producto a comercializar es inicialmente de tipo binario, pero después éste caso se extiende y continúa. La confianza de los agentes acentúa las valoraciones individuales, pero no fortalece necesariamente el contrato. La información relativa a valoración y costos tiende a ser compilada sólo por una de las partes contratantes, y se mantiene como información privada sin acceso de la contra parte y sin ser verificable ni siquiera en un tribunal. En caso de un conflicto, una de las partes puede contemplar un incumplimiento anticipado del contrato. Este artículo muestra categóricamente que en un escenario de información asimétrica, un simple contrato incompleto, aún bajo un régimen de daños y perjuicios impuestos por un tribunal, no garantiza un incentivo de confianza apropiado para ambas partes simultáneamente. Asimismo, la renegociación no ayuda a restablecer la eficiencia *ex post*, en comparación a un caso de información simétrica. Cuando el interés de anticipo de la víctima del incumplimiento es difícil de determinar por la corte, ¿cómo puede un mecanismo de revelación directa resolver el problema de riesgo moral, evaluar los daños y perjuicios anticipados correctamente sin oponerse a la eficiencia *ex post*? Concluimos entonces que tomar una medida de liquidación diseñada para daños y perjuicios para cada una de partes es superior a todos los demás procedimientos de compensación por daños y perjuicios impuestos por un tribunal.

Palabras clave autor: derecho de los contratos, incumplimiento del contrato, contratos incompletos, riesgo moral, diseño de mecanismos.

Palabras clave descriptor: derecho de los contratos, daños y perjuicios, información asimétrica.

Clasificación JEL: D82, D86, K12.

LES DOMMAGES ET INTÉRÊTS D'ORIGINE CONTRACTUELLE: NOUVELLES PERSPECTIVES QUANT AUX CONTRATS BILATÉRAUX AVEC ASYMÉTRIE D'INFORMATION

RÉSUMÉ

Cet article explore les questions économiques du contrat lorsque sont établis des accords bilatéraux avec une information post-contractuelle asymétrique unilatérale, question qui aide à formuler un modèle optimal de contrat et de réparation des dommages et préjudices. La quantité choisie de produit à commercialiser est initialement de type binaire, mais ensuite ce cas est étendu et continue. La confiance des agents accentue les estimations individuelles, mais ne fortifie pas nécessairement le contrat. L'information relative à l'estimation et aux coûts tend à être compilée seulement par l'une des parties contractantes, et est maintenue comme information privée - sans accès de la contre partie et sans même être vérifiable devant un tribunal. En cas de conflit, l'une des parties peut considérer un manquement anticipé du contrat. Cet article montre de manière catégorique que, dans un environnement d'information asymétrique, un simple contrat incomplet, même sous un régime de dommages et préjudices imposés par un tribunal, ne garantit pas une incitation à la confiance appropriée pour les deux parties simultanément. De même, la renégociation n'aide pas à rétablir l'efficience *ex post*, en comparaison à un cas d'information symétrique. Quand l'intérêt d'anticipation de la victime du manquement est difficile à établir par le tribunal, comment un mécanisme de révélation directe peut-il résoudre le problème d´aléa moral, évaluer les dommages et les préjudices anticipés correctement sans s'opposer à l'efficience *ex post*? Nous concluons alors que prendre une mesure de liquidation conçue en cas de dommages et de préjudices pour chacune des parties est supérieur à toutes les autres procédures de compensation pour dommages et préjudices imposés par un tribunal.

Mots clés auteur: droit des contrats, non-respect du contrat, contrats incomplets, risque moral, conception de mécanismes.

Mots clés descripteur: droit des contrats, dommages et préjudices, information asymétrique.

Classification JEL: D82, D86, K12.

INTRODUCTION

Contract law economic analysis in the past have shown (e.g. Shavell 1980, 2004) that in an environment with unilateral reliance investment and *ex post* symmetric information, there are incentives towards excessive reliance under both the expectation measure and there liance measure. It has also been argued that when there is no explicit damage payment, the victim of breach has an incentive to under invest in reliance. However, Edlin and Reichelstein (1996, hereafter ER) debated the over-reliance result in question: In a setting of continuous quantity choice, they showed that the expectation or the specific damage measures provide efficient incentives if the reliance investment is one-sided; the contract specifies some suitable intermediate quantity of trade as a performance obligation and the inefficient performance choices are renegotiated without any costs *ex post*. They found that a continuous quantity in the contract is a powerful tool to adjust incentives. Nevertheless, when both the parties invest using a determined and linear cost function, ER showed that it was not possible to achieve the first best level with expectation damages, at least not for all types of payoff functions. They also observed that specific performance remedy induces a symmetry that allows simple contracts to obtain the first best level for a particular class of payoff functions.

In this article, we extend the basic unilateral investment models discussed earlier in the literature in a two-sided reliance investments scenario where one of the contracting parties receives private information about its utility[1] after some time, with profit or cost functions that remain hidden to the other party and to courts. Investments are specific to the relation, but are not contractible and a party's investment does not directly affect the other party's payoff, it only affects it indirectly via the optimal quantity, which increases if the parties' investments increase as well. As for the quantity choice of the specific commodity, we start with a model of binary performance choice but later extend the analysis to continuous choice in order to add more realism, as many bilateral trade relationships involve trading divisible goods and agents can have general utility and cost functions. More importantly, this general treatment helps uncover the fundamental forces that shape optimal contracts, as well as the optimal

1 Ackerlof (1970) was the first to postulate the issue of asymmetric information in the contractual scenarios. A recent article by Korobkin and Ulen (2000) summarizes the impact of asymmetric information on decision biases as a basis for legal policy.

damage remedy in a canonical contracting problem with post contractual informational asymmetry[2].

All the common court-imposed damage measures are systematically explored, beginning with a standard analysis of the behavioural effects of restitution, reliance and expectation damages when the losses to the victim of contract breach can be thoroughly assessed by court. Further discussions focus on the application of these damage measures in situations where courts cannot thoroughly assess the victim's valuations of the contract, as these rely on private information.

When both the parties make selfish investments into the respective individual valuation function and thereby augment the social surplus, any damage measure –to be optimal– should induce efficient *ex ante* reliance investments for both the parties, as well as *ex post* allocated efficiency. The analysis shows that when the parties write a fixed-price contract, non-availability of any damage measure leads both the parties' reliance incentives to be held-up. Usually, the reliance damage remedy not only fails to restore allocated efficiency, but also renders both the parties with inefficient incentives to rely: victims of breach have a tendency to over invest whereas breachers tend to under invest.

Whether expectation damage provides efficient incentives or not must be verified in front of a court. We segregate two cases – whether the victim's expectancy is *ex post* verifiable or not. Our analysis shows that when the valuation of the victim of breach is observable and verifiable to court in a setting of binary performance choice, allocated efficiency is achieved under expectation damage remedy while it leads both the parties to rely excessively. On the other hand, if the victim of breach has private information, then the expectation damage is difficult to assess and the court may deny recovery to the party claiming exposure to breach. When problems of assessing the valuation are extreme, the court may turn to alternative remedies, or the parties may attempt to solve the problem themselves through liquidated damages clauses. The

2 How the likelihood of settlement might be affected by the presence of informational asymmetry and by various legal rules was discussed quite insightfully by Posner (1973).

In a similar approach, in his paper Bebchuk (1984) shows how the presence of an asymmetry might influence a parties' litigation and settlement decisions, and how it might lead to a failure to settle. However, in this article, one party has more information about the other, apart from his own, including an expected payoff in case an agreement is not reached and a trial takes place. Furthermore, in his model of a private law dispute, the potential plaintiff would prefer to extract from the defendant the highest amount possible in a settlement. This is somewhat a different domain than our present work focuses upon.

In contrast, similar to Fudenberg and Tirole (1983) and Rubinstein (1983), we assume that the private information that parties have is only about their own preferences, and thus only about their own payoffs.

In a recent independent working paper, UrsSchweizer (2006) seeks to advance the analysis in the same direction. The present article abstracts the bargaining procedure from Schweizer. He focuses on a unilateral reliance, whereas we focus on bilateral investment.

analysis also considers whether these solutions to the valuation problem alleviate or exacerbate opportunistic behaviour by the parties.

Thus, we render a special focus on the issue of assessing expectation damages under asymmetric information using a particular class of revelation mechanisms of the Clarke-Groves type that assesses expectation damages correctly. Further analysis shows that this mechanism generally achieves the first best level.

As it turns out, assessing expectation damages correctly comes at a price in terms of efficiency loss. It is shown that mechanisms assessing expectation damages correctly will implement performance decisions only that are constant over states. Typically, such outcomes fail to be *ex post* efficient, since asymmetric information (*ex post*) is a source of transaction costs and hence, the Coase Theorem may fail to hold, as shown by the impossibility result of Myerson and Satterthwaite (1981). Therefore, assessing expectation damages correctly is contradictory to *ex post* efficiency. In any case, renegotiations under asymmetric information, if at all possible, cannot be expected to restore *ex post* efficiency, as would have been the case under Edlin and Reichelstein's symmetric information.

Thus, while expectation damages may work well under symmetric information, at least given a continuous performance choice, the performance of expectation damages, as well as other court-imposed damages under asymmetric information, falls short of what more general mechanisms and party designed liquidated damages can achieve.

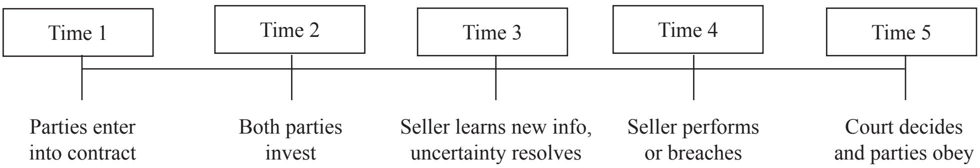
1. The Model: Bilateral Reliance and One-sided Private Information

1.1. General Setting

Let us consider a particular contract with a single (male) buyer, B, who contracts to purchase one unit of an indivisible specific good from a single (female) seller S. Both are risk-neutral. The parties enter into a simple fixed-price contract at Time 1. At the time of contracting, the parties are in a bilateral bargaining situation. The seller will later produce the good and will deliver it to the buyer at some future date. The buyer's valuation is dependent on the level of investment he undertakes and denoted by $v = V(r^b)$ of reliance investments with a maximum $\overline{V} = \max_{r^b \in R} V(r^b)$ and a minimum $\underline{V} = \min_{r^b \in R} V(r^b)$. We assume that $V(r^b)$ is monotonically increasing and strictly concave: $V'(r^b)>0$ and $V''(r^b)<0$, where r^b is the investment made by each buyer. In a similar way, the seller also undertakes investment to reduce her cost of production. To accommodate this feature, we need to ascribe a special structure to the seller's cost. The sole source of uncertainty in this model comes from the future fluctuation that hovers around the seller's production cost, which may be due to potential fluctuations in the market prices. We hereby denote the seller's production cost as $c \in [\underline{c}, \overline{c}]$, with $c=C(r^s)+\theta$, where the expected value of c is denoted by $E(c)$ and $E(c)=C(r^s)$, so that $E(\theta)=0$ when θ is a random variable which is distributed in the interval $[-a,a]$ with $a>0$, according to a cumulative distribution function denoted by $F(\theta)$ with positive continuous density function $f(\theta)>0$ with zero mean and variance σ_θ^2. The uncertainty parameter θ is private information to the seller, which she learns after the initial contract has been signed. The distribution $F(\theta)$ is common knowledge. Moreover, we make the standard assumptions to get a "well behaved" problem, $C'(r^s)<0$, $C''(r^s)>0$. At this point we simply assume that these reliance investments are *ex ante* indescribable and thus non-contractible. In case they are verifiable *ex post* in court, then reliance damage may apply.

Figure N° 1

Periodic Structure for the Contract Model



Source: Own elaboration

The sequence of events can be summarised as follows:

The parties sign a contract and specify the delivery price p at Time 1 → Both the buyer and the seller make reliance investment at Time 2 → The seller observes her cost of production c at Time 3 as uncertainty resolves → The seller decides whether to perform the contract or repudiate at Time 4 → If the seller breaches, the buyer files a lawsuit at no cost in between Time 4 & 5 → The court awards damages of D, which may be a function of investments and p at Time 5.

1.2. The Analysis: First Best Level

The first best level is achieved if the *ex-ante* investment decision and the *ex post* trade decision are efficiently made. The *ex post* efficient trade decision is to exchange the specific good whenever the seller's Time 4 costs are less than the buyer's valuation, while *ex ante* efficient level of investment maximises the total expected surplus, including both the buyer's and the seller's investment costs given the *ex post* efficient trade decision.

Thus, in an *ex post* sense, ignoring the "sunk costs" of investments, contract breach is efficient if: $v< c$; otherwise performance is efficient. Thus,

$$Prob[performance] = Pr[c \leq V(r^b)] = Pr[C(r^s) + \theta \leq V(r^b)]$$

$$= Pr[\theta \leq V(r^b) - C(r^s)] = F[V(r^b) - C(r^s)] \quad \textbf{(1)}$$

And

$$Prob[breach] = 1 - Prob[performance] = 1 - F[V(r^b) - C(r^s)] \quad \textbf{(2)}$$

Thus, the expected joint payoff would be

$$EPJ = F[V(r^b) - C(r^s)].[\{V(r^b) - r^b - p\} + \{p - E(c \mid c \leq V(r^b)) - r^s\}]$$

$$+ \{1 - F[V(r^b) - C(r^s)]\}.\{0 + 0 - r^b - r^s\}$$

$$= F[V(r^b) - C(r^s)].\{V(r^b) - E(c|C(r^s) + \theta \leq V(r^b))\} - r^b - r^s \quad \textbf{(3)}$$

To check the investment incentives for the contracting parties, we need to differentiate[3] the expression above. To complete our analysis we need the following technical assumptions –

1. $F[V(0)].V'(0)>1$.
2. $\frac{\partial}{\partial r^b} \{F[V(r^b)].V'(r^b)\}<0$.
3. The distribution $F(.)$ follows monotone hazard rate.

Explanation: Our third assumption states that both $((1-F(x))/f(x)$ and $f(x)/F(x)$ are decreasing in x. This is a standard and fairly mild assumption, often used in literature. The first assumption necessarily implies that $V(0) \geq \underline{c}$, i.e. the contract breach and the eventual separation between the trading parties are never efficient when $c = \underline{c}$. This is sufficient for the efficient level of investment to be strictly positive. (From $V'(r^b) \to 0$ for $r^b \to \infty$, it follows that the efficient investment level would be finite).

The second assumption guarantees a unique solution $\{r^{b*}, r^{s*}\}$ (a Kaldor-Hicks efficient level of reliance vector that maximises this joint value) for the followingf.o.c.s:

For the buyer:

3 For the purpose of differentiation, we have used the following fundamental theorem of integration formula: $\frac{d}{dt}\int_{q(t)}^{h(t)} f(x)dx = f(h(t)).h'(t) - f(q(t)).q'(t)$

$$EPJ'(r^b) = f(.).V'(r^b).\ V(r^b)+F(.).V'(r^b) -\ f(.).V'(r^b).\ V(r^b) - 1 = 0$$

$$\Rightarrow V'(r^{b*}) = \frac{1}{F[V(r^b*)-C(r^s*)]} > 1,\ [\because V'(r^b)>0,\ V''(r^b)<0] \quad \textbf{(4)}$$

For the seller:

$$EPJ'(r^s) = f(.).(-C'(r^s)).\ V(r^b) - f(.).(\ -C'(r^s)).\ V(r^b)+F(.).(-C'(r^s)) - 1= 0$$

$$\Rightarrow -\ C'(r^{s*}) = \frac{1}{F[V(r^b*)-C(r^s*)]} > 1,\ [\because C'(r^s)<0,\ C''(r^s)>0] \quad \textbf{(5)}$$

The term $F[V(.)-C(.)]$ in the first order equilibrium condition reflects the probability that the specific investment actually pays off and the efficient level of investment is an increasing function of this probability.

2. Court-imposed Remedies for Breach of Contract

Given the conditions for socially optimal breach and investments, we now turn to assess the impact of available remedies. We will start with reliance and restitution damages.

2.1. Reliance and Restitution Damage Measures

Since we consider here a case of unilateral breach by the seller, let us denote the reliance damage to the buyer by $D_r = \beta.\ r^b$,where $\beta \in [0,1]$ is that part of the entire reliance undertaken by the buyer which is *ex post* verifiable in court, postponing the debate on verifiability of reliance for the time being. Here we have identified a relation between the reliance damage and the restitution damage measures through the variation in the value of β; when $\beta=1$, full reliance cost is recoverable and when $\beta=0$, no damage is recovered which is synonymous to restitution damage.

Now the seller's payoff when the contract is honoured is: $P - c$; and when she breaches her wealth: $-D_r$.Therefore, the seller chooses to perform when: $P - c \geq -D_r$ i.e. $P + \beta.r^b \geq c$, otherwise, he will breach. Thus the seller breaches too frequently relatively to the first best level. Therefore, $Pr[performance] = Pr[c<P+ \beta.r^b] = F[P+ \beta.r^b - C(r^s)]$

Now the buyer's expected payoff would be

$$F[P+ \beta.r^b - C(r^s)].[V(r^b) - r^b - P] + \{1 - F[P+ \beta.r^b - C(r^s)]\}.\{\beta.r^b - r^b\} \quad \textbf{(6)}$$

The first order condition for the buyer's payoff maximisation can be derived as

$$EPB'(r^b) = f(.).\beta.[V(r^b) - P - \beta.r^b] + F(.).V'(r^b) - (1-\beta) - F(.).\beta = 0 \quad \textbf{(7)}$$

$$\Rightarrow V'(r^b) = (1-\beta)/F(.) + \beta - \beta.\ [V(r^b) - P - \beta.\ r^b].f(.)/F(.), \text{if } 0<\beta<1$$

$$= 1 - [V(r^b) - P - r^b].\ f\,[P + r^b - C(r^b)]\ /\ F\ [P + r^b - C\ (r^s)], \text{ if } \beta=1$$

$$= 1\ /\ F\ [P + C\ (r^s)], \text{ if } \beta=0, \text{ [equivalent to restitution damage]}$$

Similarly, the seller's expected payoff would be

$$EPS = F(.).[P - r^s - E(c|c \le P + \beta.\ r^b)] + \{1 - F(.)\}.[-\beta.\ r^b - r^s]$$

The first order condition for the seller's payoff maximisation can be derived as

$$EPS'(r^s) = F(.).[-C'(r^s)] - 1 = 0 \quad \textbf{(8)}$$

$$\Rightarrow -C'(r^s) = 1/F[P + \beta.r^b - C(r^s)], \quad \text{if } 0<\beta<1$$

$$= [P + \beta.r^b - C(r^s)], \quad \text{if } \beta=1$$

$$= 1/F[P - C(r^s)], \quad \text{if } \beta=0, \text{ [equivalent to restitution damage]}$$

We now compare the reliance levels by the buyer and the seller under the two different remedies with those chosen in the first best setting.

2.1.1. Restitution Measure (when β=0)

Note that, since $V(r) > p$, we must have $F[P - C(r^s)] < F[V(r^b) - C(r^s)]$, and so:

For the buyer:

$$V'(r^b{}_S) = \frac{1}{F[P - C(r^s{}_S)]} > \frac{1}{F[V(r^b*) - C(r^s*)]} \quad \textbf{(9)}$$

⇒ The buyer under invests in reliance compared to the first best level.

And for the seller:

$$-C'(r^s{}_S) = \frac{1}{F[P - C(r^s{}_S)]} > \frac{1}{F[V(r^b*) - C(r^s*)]} \quad \textbf{(10)}$$

⇒ The seller also makes less investment in respect to the first best level.

Comparing (4) with (9) and (5) with (10), we can establish the following proposal:

Proposal 1: In a fixed-price contract under a regime of no contractual damage liability, each party chooses a level of reliance investment that is less than the first best level, given the other party's investment.

Remarks:

1. Divergence between Private and Social Gain: The distorted investment result arises from the divergence between a party's private gain and the social benefit from reliance. From the social point of view, the buyer should raise r^b so long as the benefit increased surplus, exceeding the marginal cost of 1. However, from the buyer's private point of view, it pays to raise r^b as long as his private benefit, in terms of the fraction of the surplus he can extract, exceeds his marginal cost of 1. Since the buyer in this case has to internalise the social cost of breaching and he expects to be "held up", he does not capture the full benefit of his reliance but only a fraction of it, leading to strike a suboptimal balance.

2. The seller would also undertake less investment compared to the first best level due to: First, in case of breach, she does not need to make any monitory payment; and secondly, as she breaches too frequently given a contractually specified low price, her motivation to invest in reducing the cost does not get the required encouragement.

3. During the bargaining of the contractual price, in case the seller is capable of raising it, the reliance investments by both parties would increase accordingly.

4. The under investment problem basically stems from *ex post* allocated inefficiency, which in turn depends on the initial contractual price.

2.1.2. Reliance Measure (when B=1)

For the buyer:

$$V'(r^b) = 1 - [V(r^b) - P - \beta.\ r^b_R].\ \frac{f[P + r^b_R - C(r^s_R)]}{F[P + r^b_R - C(r^s_R)]} \leq 1 < \frac{1}{F[V(r^b*) - C(r^s*)]} \qquad \textbf{(11)}$$

⇒ Thus, the buyer would over invest compared to the first best level.

And for the seller:

$$-C'(r^s) = \frac{1}{F[P + r^b_R - C(r^s_R)]} > \frac{1}{F[V(r^b*) - C(r^s*)]} \qquad \textbf{(12)}$$

⇒ The seller still invests less in relation to the first best level; but the amount is higher when compared to a no damage situation, since we have $F[P - C(r^s)] < F[P+r^b - C(r^s)]$.

We summarise the results above as follows–

Proposal 2: With a fixed-price contract under a regime of reliance damage liability, the uninformed victim i.e. the buyer-, will over-invest in reliance given the other party's level of reliance, whereas the other party i.e. the informed breacher, would under invest in reliance, regardless of the buyer´s level of reliance.

Remarks: Intuition –In reliance damages, the victim (buyer) can shift the cost of reliance to the other party only in the event of contract breach, as in this contingency the seller (breacher) has to pay r^b. At the same time, the benefit from increasing his investment is greater than merely the added value created; the benefit also includes the increased likelihood that the contract will be performed rather than breached. This induces the seller to raise her level of investment, so as to reduce the likelihood of suffering the cost of increased damages. With a higher precaution level, the buyer would be more likely to receive $V(r^b)$, rather than just r^b, and we know that $V(r^b)>r^b$. The seller under invests in reliance because she has to protect herself from part of the loss that can occur. Although the total loss from breach is $V(r^b)$, the seller would sustain only a fraction of it, i.e.r^b. Note that the higher the initial contracted price is, both parties tend to rely more.

2.2. EXPECTATION DAMAGE

Expectation damages are measured *ex post* to make the injured party has the same benefits as if the contract was fully performed. Thus, the damage stands at: $D_e=V(r^b)-p$. Therefore, the seller would perform only when $p-C\geq -D_e$ i.e. $C\leq V(r^b)$, otherwise she breaches the contract. Now, $Prob[performance]=F[V(r^b)-C(r^s)]$.

Thus the buyer's expected payoff becomes

$$EPB_e = F[V(r^b) - C(r^s)].[V(r^b) - r^b - p]+[1 - F(.)].[D_e - r^b] = V(r^b) - r^b - p$$

Therefore the F.O.C. is

$$V'(r_E^b)=1. \tag{13}$$

⇒ the buyer makes an over investment in reliance.

Similarly, the seller's expected payoff becomes

$$EPS_e = F[V(r^b) - C(r^s)].[p-E(c|c\leq V(r^b))-r^s]+[1-F(.)][-D_e+p-r^s]$$

$$= p - r^s - V(r^b)+F(.).V(r^b) - F(.).E(c|\ c \leq V(r^b)).$$

The F.O.C. implies that

$$EPS_e'(r_s^{\,b}) = -1 + f(.).(-\,C'(r_s^{\,b})).V(r^b) - f(.).(-\,C'(r^s)).V(r^b) - F(.).C'(r^s) = 0$$

$$\Rightarrow F[V(r^b) - C(r^s)].C'(r^s) = -1$$

$$\Rightarrow -\,C'(r_E^{\,s}) = \frac{1}{F[V(r_E^b) - C(r_E^s)]} < \frac{1}{F[V(r^b*) - C(r^s*)]} = -C'\left(r^s*\right) \qquad \textbf{(14)}$$

⇒ The seller makes an over investment in reliance.

Remarks:

1. Intuition for the buyer´s over-investment: Let's suppose the buyer can make an investment that will increase the value only if both parties trade. If the trade turns out to be inefficient i.e. the seller's costs exceed the buyer's value, the investments would have been wasted. The buyer, in choosing an investment level, should consider the return on reliance in world States where they trade − positive, and the return on reliance in world States where the parties do not trade − zero. Contract law awards buyers the difference between his valuation, given his reliance, and the price when the parties do not trade; the buyer thus is fully insured against lost valuations regardless of the chosen investment level. Thus, the buyer invests too much.

2. Intuition behind the seller´s over investment in reliance: In the expectation measure, the buyer chooses an excessive level of reliance, and the seller has to fully internalise the buyer's actual loss from a breach. This makes the breach contingency more costly for the seller than it would have been under optimal reliance. Hence, the seller increases her investments, to reduce the likelihood of sustaining this enhanced cost.

3. It can be easily shown that when one of the two contracting parties possessing *ex post* private information simultaneously controls the reliance decision and the breach decision, the first best solution can be achieved under expectation damage with a fixed-price contract in a unilateral investment framework, provided trade is a binary choice i.e. $\{0,1\}$.

We can establish from the above discussions important claims–

Claim 1: In the case of one-sided asymmetry under a fixed price, an incomplete contract with a binary trading choice: (a) one-sided investment: if only the breaching party who has ex post private information invests, then the expectation damage remedy would induce efficient reliance investment, (b) bilateral investment: the expectation damage remedy would induce both parties to over invest. Efficient breach is always achieved.

3. Further Insights on Private Information, Expectation Damage and Investment Incentives: A Mechanism Design Approach

So far, we have considered a case where the informed party chooses to breach the contract; where the victim's expectation interest assessment by court was possible. In this subsection, we will allow the breach by either of the two parties irrespective, whether it holds private information or not. When the non-breaching party holds the private information, the verification of expectation damage is difficult. In this situation, the party may be denied the recovery of expectation damage since the court may be unable to measure it correctly. This has a direct implication in the incentives awarded to the parties under expectation damage.

3.1. The general setting[4]

As in the previous situation, a buyer (B) and a seller (S), both risk-neutral, after signing a contract, choose to make reliance investments $r^b, r^s \in R^+ = [0,\infty)$ before nature reveals the value of parameter θ from an interval $\Theta = [\theta_L, \theta_H]$ where $\theta_H > \theta_L \geq 0$, where θ is a random variable and its realisation is observed only by one party and is thereby, not contractible. The other party has a prior probability distribution over θ. After θ is realised, the performance decision $q \in Q$ is made. In the present setting, Q is assumed to be a subset of the positive real line of an interval $Q = [q_L, q_H]$[5]. Notice here that so far we have been using a binary choice model in the same ethos as Shavell (1980), whereas Edlin and Reichelstein (1996) deal with continuous performance choice. At relevant places, comments on binary setting are made.

Let's say, *ex post* trading surplus amounts to

$G^b(r^b,r^s,\theta,q) = V(r^b,\theta,q) - C(q,r^s)$, if B holds private information,

And

$G^s(r^b,r^s,\theta,q) = V(r^b,q) - C(q,\theta,r^s)$, if S holds private information;

where $V(r^b,.)$ denotes the buyer's valuation function and $C(r^s,.)$ the seller's cost function.

4 This is an adaptation of Urs Schweizer's model (2006) to accommodate bilateral reliance.

5 Alternatively, it may be just binary $Q = \{qL, qH\}$, equivalently $\{0,1\}$ i.e. $(qL = 0)$ stands for not performed and $(qH = 1)$ means performed. In the case of continuous performance choice, q can be thought of as the quantity or quality of a divisible good to be exchanged.

In either case, at the investment stage, the effect of reliance investments on social surplus is uncertain due to the presence of uncertainty factor θ. These two cases are to be treated separately. Continuing with the current analysis here, we shall take up the case when only the seller holds the private information but either party can unilaterally choose to breach. The buyer's private information case can be dealt in a similar way. We require the following assumptions for optimal and interior solutions.

Assumptions:

a) $V(.)$ is increasing and strictly concave in q; i.e. if $q<q'$ then $V(.,q)<V(.,q')$.

b) $C(.)$ is increasing and strictly convex in q; i.e. if $q<q'$ then $C(.,q)<C(.,q')$.

c) If $\theta<\theta'$, then $V(.,\theta')>V(.,\theta)$, $\forall r^b,q$.

d) If $\theta<\theta'$, then $C(.,\theta')<C(.,\theta), \forall r^s,q$.

Explanation: Assumption (a) requires the buyer's payoff net of investment costs to be strictly monotonically increasing and concave as a function of performance choice. Assumption (b) requires that the seller's payoffs net of investment costs to be monotonically increasing and concave. Assumption (c) guarantees that the buyer's payoff increases in respect to increase in θ i.e. private information. Similarly, assumption (d) requires that as private information factor rises for the seller, its costs decrease.

3.2. THE FIRST BEST

We construct the first best solution through backwards induction, as a reference point. The *ex post* socially best response performance choice exists being $q^+(r^b,r^s,\theta)\in\arg\max_{q\in Q} G^s(r^b,r^s,\theta,q)$ which maximises social surplus at the performance stage (*ex post*) when reliance investment and the move of nature are given. Note that this performance choice is unique[6] for each type. Accordingly, we define the social surplus net of investment costs as: $W(r^b,r^s,\theta,q^+)=V(r^b,q^+)-C(r^s,\theta,q^+)-r^b-r^s$, [Sholds private info].

Thus, the efficient level of reliance is then defined as:

For the buyer

$$r^{b*}\in \arg\max_{r^b\in R} E_\theta[W(r^b,r^s,\theta,q^+(r^b,r^s,\theta))]$$

6 Efficient trades' uniqueness simplifies the exposition, but all the results can be restated for multiple efficient trades. Indeed, note that slogan 2 (see infra) holds up with multiple maximisers, for any selection of maximisers. One way to ensure single value is by assuming that $W(r^b,r^s,\theta,q)$ is strictly concave in q, which is actually done here.

For the seller

$r^{s*} \in \arg\max_{r^s \in R} \; E_\theta[W(r^b, r^s, \theta, q^+(r^b, r^s, \theta))],$

Maximising the *ex-ante* expected social surplus. Folding back these efficient reliance choices in the socially best performance decision, we therefore define the efficient performance choice as $q^*(\theta)=q^*(r^{b*}, r^{s*}, \theta)$, i.e. this is the socially best response to efficient reliance investments. Then the following conditions must hold

$$r^{b*} \in \arg\max_{r^b \in R} E_\theta[W(r^b, r^s, \theta, q^*(\theta))] \quad \textbf{(15)}$$

And

$$r^{s*} \in \arg\max_{r^s \in R} \; E_\theta[W(r^b, r^s, \theta, q^*(\theta))]. \quad \textbf{(16)}$$

Before proceeding any further, we establish three important auxiliary results for later reference. We used a tool known as "monotone comparative statics", which investigates the optimum points of a system in respect to changes in the parameters in a monotonic way (i.e., the solution is always either non-increasing or non-decreasing in parameter).

The key to ensure monotone comparative statics is the following[7]:

Assumptions:

e) For the function $W(.)$, if $\theta<\theta'$, then $\{W(r^b, r^s, \theta', q) - W(r^b, r^s, \theta, q)\}$ is strictly monotonically increasing as a function of $q \in Q$. [SCP]

f) For the function $W(r^b, r^s, \theta, q)$, $\forall\; q''>q'$ when $q'', q' \in Q$, the difference $\{W(., \theta, q'') - W(., \theta, q')\}$ is strictly increasing in $\theta \in \Theta$. [ID]

g) If $q<q'$ then the difference $\{W(r^b, r^s, \theta, q') - W(r^b, r^s, \theta, q)\}$ is monotonically increasing as a function of r^j, $\forall\; j=b,s$.

Explanation: The condition (e) is well-known as 'single-crossing property'[8] in mechanism design. Similarly, (g) it means that in net investment costs, the marginal social product is an increasing function of investments. This means that investments are specific. And finally, assumption (f) is known as 'Increasing Difference'[9]. It turns out

7 Note here that we used a discrete type for analytical convenience.

8 In a differentiable setting, this would hold if the second derivative $W_{\theta q}>0$ is positive. The Single-Crossing Property was first suggested by Spence (1972) and Mirrlees (1971). Our definition is a simplified version for preferences that are quasi-linear in transferst. Our SCP was introduced by Edlin-Shannon (1998) under the name "increasing marginal returns".

9 This property is more precisely called strictly increasing difference, see Topkis (1998).

that the analysis of contracting is dramatically simplified when the Agent's types can be ordered so that higher types choose a higher consumption.

We now establish the following three important slogans for future references.

Slogan 1: If $W(r^b,r^s,\theta,q)$ is continuously differentiable and satisfies SCP, and Q is an interval, then $W(r^b,r^s,\theta,q)$ satisfies ID.

Proof: For $\theta''>\theta',[\forall\ \theta'',\theta'\in\Theta]$ we have,

$$W(r^b,r^s,\theta'',q'')-W(r^b,r^s,\theta'',q')=\int_{q'}^{q''}W_q\ (r^b,r^s,\theta'',q)dq$$

$$>\int_{q'}^{q''}W_q\ (r^b,r^s,\theta',q)dq=W(r^b,r^s,\theta',q'')-W(r^b,r^s,\theta',q'). \quad \textbf{(17)}$$

Note that if the Agent's value function $V(.,\theta,q)$ satisfies ID, then the indifference curves for two different types of Agent, θ' and $\theta''>\theta'$, cannot intersect more than once. Indeed, if they intersected at two points (q',t') , (q'',t'') with $q''>q'$, this would mean that the benefit of increasing q from q' to q'' exactly equals $\{t'-t''\}$ for both types θ' and θ'', which contradicts ID. This observation justifies the name of "single-crossing property".

A key result in monotone comparative statics says that when the objective function satisfies ID, maximisers are non-decreasing in the parameter value θ. Moreover, if SCP holds and maximisers are interior, they are strictly increasing in the parameter.

Formally:

Slogan 2: Under the single-crossing property, the socially best response performance choice is in the interior of Q and is a monotonically increasing function of private information held by the contracting parties; i.e. ex post efficient performance choice will typically be state-contingent and interior.

In other words:

If $\theta'>\theta,\ q^+(r^b,r^s,\theta')\in argmax_{q\in Q}W(r^b,r^s,\theta',q)$ and $q^+(r^b,r^s,\theta)\in argmax_{q\in Q}W(r^b,r^s,\theta,q)$.

Thus,

a) If $W(.,\theta,q)$ satisfies *ID,* then $q^+(r^b,r^s,\theta')\geq q^+(r^b,r^s,\theta)$.

b) If, moreover, $W(.,\theta,q)$ satisfies *SCP,* and either $q^+(r^b,r^s,\theta)$ *or* $q^+(r^b,r^s,\theta')$ is in interior of Q *[i.e.* $q_L(r^b,r^s,\theta)\leq q^+(r^b,r^s,\theta)\leq q_H(r^b,r^s,\theta)]$, then $q^+(r^b,r^s,\theta')>q^+(r^b,r^s,\theta)$; where q_L and q_H are respectively some low level and high level of quantities.

Proof: We prove the slogan in two steps. In the first step, we show that the *ex post* performance choice is state-contingent; and in the second step, we demonstrate that the socially best response quantity choice is an interior solution for a given realisation of the information parameter. For notational simplicity, we suppress the reliance arguments.

Step 1: Following revealed preferences by construction

$W(.,\theta,q^+(.,\theta))\geq W(.,\theta,q^+(.,\theta'))$ and $W(.,\theta',q^+(.,\theta'))\geq W(.,\theta',q^+(.,\theta))$.

Adding up vertically and rearranging the terms

$W(.,\theta',q^+(.,\theta')) - W(.,\theta',q^+(.,\theta))\geq W(.,\theta,q^+(.,\theta')) - W(.,\theta,q^+(.,\theta))$.

Notice here that this is the same condition as our ID. By ID, this inequality is only possible when $q^+(r^b,r^s,\theta')>q^+(r^b,r^s,\theta)$. Hence, it is proven.

In a similar way, we can further prove that

$W(.,\theta',q^+(.,\theta'))>W(.,\theta,q^+(.,\theta'))$, and $W(.,\theta,q^+(.,\theta))<W(.,\theta',q^+(.,\theta))$.

$\Rightarrow$ *Ex post* efficient performance choice is positively dependent on private information.

Step 2: For some performance decision $q_H(r^b,r^s,\theta)>q^+(r^b,r^s,\theta)$, by assumption(e), $W(.,\theta',q^+(.,\theta)) - W(.,\theta,q^+(.,\theta)) \leq W(.,\theta',q_H(.,\theta)) - W(.,\theta,q_H(.,\theta))$

And hence,

$W(.,\theta,q_H(.,\theta)) < W(.,\theta,q^+(.,\theta)) - \{W(.,\theta',q^+(.,\theta)) - W(.,\theta',q_H(.,\theta))\} \leq W(.,\theta,q^+(.,\theta))$

$\Rightarrow$ For a particular realisation of θ, there is no performance decision in the range above $q^+(r^b,r^s,\theta)$ that maximises $W(r^b,r^s,\theta,q)$. In a similar way, we can also prove that for any performance choice in the range below $q^+(r^b,r^s,\theta)$ [i.e. say, $q_L(r^b,r^s,\theta) < q^+(r^b,r^s,\theta)$] the welfare $W(r^b,r^s,\theta,q)$ won't be maximised, and hence, Slogan 2 is partially established.

Alternatively, assuming definitely that $q^+(.,\theta)$ is in the interior of Q, then the following first order condition must hold: $W_q(.,\theta,q^+(.,\theta))=0$.

By SCP we have $W_q(.,\theta',q^+(.,\theta))>W_q(.,\theta,q^+(.,\theta))=0$, and therefore $q^+(.,\theta)$ cannot be optimal for parameter value θ', a small increase in q would increase $W(.)$. Since by assumption (a), $q^+(.,\theta') \geq q^+(.,\theta)$, we must have $q^+(.,\theta') > q^+(.,\theta)$.

Note: In a differentiable setting where the socially best response is an interior solution, the socially best response quantity (performance) choice will be strictly monotonically increasing as a function of private information. In particular, *ex post* efficient performance choice will typically be state-contingent.

Slogan 3: Some constant contractual performance decisions exist [other than $q^{+}(.)$] where the ex-ante optimal reliance investments turn out to be lower or higher when compared to the first best efficient level of investments.

Alternatively, let's suppose assumption (g) is met and an optimal level of reliance for each quantity choice is achieved.

Alternatively, let's suppose assumption (g) is met. Then, for all $i=L,H$ and $j=b,s;$ a choice of reliance exists, $r_i^j \in \arg\max_{r_i^j \in R} E_\theta[W(r^b, r^s, \theta, q_i)]$ such that $r_L^j \leq r^{j*} \leq r_H^j$ corresponding to $q_L \leq q^{+} \leq q_H$.

Proof: Given r^{b*} and any contractual performance choice q_L (where $q_L < q^*$), for any investment by the seller $r^s > r^{s*}$, following the assumption (f):

$$W(r^{b*},r^{s*},\theta,q^*(\theta)) - W(r^{b*},r^{s*},\theta,q_L) \leq W(r^{b*},r^s,\theta,q^*(\theta)) - W(r^{b*},r^s,\theta,q_L)$$

Now taking expectation on both sides and changing sides, we get that

$$E_\theta[W(r^{b*},r^s,\theta,q_L)] \leq E_\theta[W(r^{b*},r^{s*},\theta,q_L)] - E_\theta\{W(r^{b*},r^{s*},\theta,q^*(\theta)) - W(r^{b*},r^s,\theta,q^*(\theta))\}$$

$\leq E_\theta[W(r^{b*},r^{s*},\theta,q_L)]$ must hold.

Thus, $E_\theta[W(r^{b*},r^s,\theta,q_L)]$ attains a maximum in the range $r^s \leq r^{s*}$ and the first claim of the slogan is established. The second claim of the slogan can be established in the similar way.

If the difference in assumption (b) is strictly monotonically increasing in r^j and also if the efficient performance is inner choice (i.e. $q^*(\theta) \in [q_L, q_H]$) with positive probability, then the claims of Slogan 3 would hold for any $r_i^j \in \arg\max_{r_i^j \in R} E_\theta[W(r^b, r^s, \theta, q_i)]$.

Note here that in a differentiable setting with continuous performance choice, Slogan 3 indicates that an intermediate performance decision $q^{oo} \in Q$ [i.e. $q_L < q^{oo} < q_H$] exists so that $r_i^{j*} \in \arg\max_{r_i^j \in R} E_\theta[W(r^b, r^s, \theta, q^{oo})]$, $\forall$j holds well. Moreover, the assumed structure of social surplus follows so that.

For the buyer:

$$\arg\max_{r^b \in R} \; E_\theta[W(r^b, r^s, \theta, q^{oo})] = \arg\max_{r^b \in R} \; [V(r^b, q^{oo}) - r^b] \quad \textbf{(18)}$$

And

For the seller:

$$\arg\max_{r^s \in R} E_\theta[W(r^b, r^s, \theta, q^{oo})] = \arg\max_{r^s \in R} \{E_\theta[C(r^s, \theta, q^{oo})] - r^s\} \quad \textbf{(19)}$$

must hold if it is the seller who obtains private information.

3.3. Mechanisms Under the Shadow of Expectation Damages

When one of the two parties' valuations has private information, it may be particularly difficult for courts to award the correct amount of damages in case the party with private information turns out to be the victim of contract breach. The parties, when confronted with such problems of hidden information, may resort to sophisticated revelation mechanisms. As introduced earlier, the general setting allows us to apply the first best solution with a Clarke-Groves type mechanism. The transfer payments under a revelation mechanism, that implement the efficient *ex post* breach and the efficient *ex ante* reliance investments by the parties, however turn out to be notably different from that of correct *ex post* expectation damages.

Thus, we rather inspect the provisions that allow awarding the correct expectation damages, even under asymmetric information. In other words, we shall investigate the class of mechanisms that reflect expectation damages along the correct equilibrium path. Following Shavell (1980) and Edlin and Reichelstein (1996), the initial contract $[q^o, T^o]$ categorically specifies the parties contractual obligations − the seller's choice of performance is fixed at $q^o \in Q$, and upon this performance the buyer must pay T^o to the seller. The two cases will be distinguished according to which party obtains private information and which party considers breaching the contract.

3.3.1. Case SB:Seller Obtains Private Information but Buyer Considers Breach

Let's suppose, just before the seller starts production, that the buyer notifies the seller to accept delivery of some quantity $q \leq q^o$ only. Therefore, he breaches for the remaining quantity and therefore owes compensation to the seller according to expectation damage. But, in principle, the seller must grant a reduction of payments in the amount of his cost savings $[C(r^s, \theta, q^o) - C(r^s, \theta, q)]$. Due to hidden information, however, courts may no longer be able to administer such a price reduction correctly.

Let's suppose a situation when information is symmetric between the parties, where it had been properly administered, then the seller's payoff would have been

$$\Psi(r^b,r^s,\theta,q) \;= T^o - C(r^s,\theta,q) - r^s - [C(r^s,\theta,q^o) - C(r^s,\theta,q)] = T^o - C(r^s,\theta,q^o) - r^s.$$

Thus, the seller in the face of anticipatory breach by the buyer is as well off since the contract is honoured when compensated through actual expectation damage. In that case, the seller's final payoff strictly depends on the initial contractual quantity choice which is q^o.

The seller would thus choose her investment according to

$$r^s_E \in \arg\max_{r^s \in R} E_\theta[\Psi(r^b,r^s,\theta,q^o)] \neq \arg\max_{r^s \in R}\; E_\theta[W(r^b,r^s,\theta,q^+(r^b,r^s,\theta))] = r^{s*}.$$

And hence, she would have an incentive to rely higher or lower than the socially best level, which crucially depends upon the initially contracted higher or lower performance choice q^o. In this case and in the light of Slogan 3, the first best solution can be implemented by just requiring the parties to specify a suitable initial contractual quantity choice $q^o = q^{oo}$ as well as demanding the buyer to mitigate damages, taking into account the seller´s per actual expectancy resulting from the breach.

If the buyer announces anticipatory breach $q \leq q^o$ upon receiving the benefit of reduction in payment to $[C(r^s,\theta,q^o) - C(r^s,\theta,q)]$, his payoff is:

$$\begin{aligned}\Phi(r^b,r^s,\theta,q) \;&= V(r^b,q) - T^o - r^b + [C(r^s,\theta,q^o) - C(r^s,\theta,q)]\\ &= [V(r^b,q) - C(r^s,\theta,q) - r^b - r^s] - [T^o - C(r^s,\theta,q^o) - r^s]\\ &= W(r^b,r^s,\theta,q) + [C(r^s,q^o) + r^s - T^o]\end{aligned}$$

which, till the first term, depends on actual performance and is equal to social surplus.

Hence, the buyer's performance choice in equilibrium solves:

$$q^+(r^b,r^s,\theta) \in \arg\max_{q \in Q}\; \Phi(r^b,r^s,\theta,q) = \arg\max_{q \in Q}\; W(r^b,r^s,\theta,q)$$

and coincides with the socially best response i.e. $q^+(r^b,r^s,\theta)$. Anticipating a quantity choice at the investment stage, the buyer would have the incentive for efficient reliance, as

$$r^{b*} \in \arg\max_{r^b \in R}\; E_\theta[\Phi(r^b,r^{s*},\theta,q^+(r^b,r^s,\theta))] = \arg\max_{r^b \in R} E_\theta[W(r^b,\boldsymbol{r^{s*}},\theta,q^+(r^b,r^s,\theta))], \quad \textbf{(20)}$$

provided the seller invests efficiently.

Note here that the expectation damages remedy entails asymmetric treatment of the contract breacher and the victim of breach, and creates a tension between providing efficient incentives for both of them simultaneously. Because damages give the injured party exactly his expectancy, he is only overcompensated for his reliance; the breacher winds up with the residual, receiving exactly the social return for her investment at the margin.

The analysis above works efficiently in a symmetric/complete information framework, but ceases to work in the presence of asymmetric information, since the state contingent actual compensation is not possible. The buyer's choice of quantity will not be state contingent depending on how the court settles the seller's expectancy. Therefore, by anticipating his *ex post* (inefficient) quantity choice, corresponding to the court's arbitrary compensation choice, he will undertake a level of investment which will be anything but efficient. However, the preceding analysis uncovers an insight that helps us design a mechanism which ensures efficiency using a message game between the parties.

• The Revelation Principle

To be able to deal with hidden information, we suppose that the informed party (here seller) would communicate a message m out of a set of alternative messages M once her private information $\theta \in \Theta$ is realised, but before the performance choice $q \in Q$ by the buyer is conveyed. The message is expected to affect the net payment (transfer), which the buyer owes to the seller and which may further depend on the seller's actual reliance investments as well as on the buyer's performance decision.

Definition 1: A transfer is a function $T(.)$ which specifies the payments that the buyer has to make in order to receive different amounts $q \in Q$ of the good.

Depending upon the verifiability of the reliance actions, the transfer schedule can be denoted either by $T(r^b,r^s,m,q)$ if reliance investments are observed by the parties and verifiable in front of court (i.e. information structure is Partial Private Information, hereafter PPI) or by $T(m,q)$ if investments are hidden actions (environment is CPI). The incentives provided by each of the mentioned transfer schedules can be calculated by backwards induction. We consider the PPI environment case first.

PPI Environment (θ is private information but investments are observable): At the performance stage (*ex post*), when the actual reliance investments and the messages are known, the buyer will choose his performance decision according to

$$q_B(r^b,r^s,m) \in \arg\max_{q \in Q} \{V(r^b,q) - T(r^b,r^s,m,q)\}.$$

Anticipating the buyer's performance choice for a particular message sent by her, the seller, upon realising her private information θ, would then send a message $m_S(r^b,r^s,\theta)\in \arg\max_{m\in M}\{T(r^b,r^s,m,q_B(r^b,r^s,m)) - C(r^s,\theta,q_B(r^b,r^s,m))\}$, that maximises her payoff.

Now, folding back this m_s into the earlier expression of q_B, we denote the resultant equilibrium performance choice by the buyer, along the equilibrium path, as a function of reliance investments of both parties and the private information of the seller, $\eta(r^b,r^s,\theta) = q_B(r^b,r^s,m_S(r^b,r^s,\theta))$, and thereby the corresponding net transfer will amount to $\tau(r^b,r^s,\theta) = T(r^b,r^s,m_S(r^b,r^s,\theta),\eta(r^b,r^s,\theta))$, such that the informed party seller's payoff will be: $I(r^b,r^s,\theta) = \tau(r^b,r^s,\theta) - r^s - C(r^s,\theta,\eta(r^b,r^s,\theta))$. This state-contingent payoff and the underlying transfer schedule, is said to reflect expectation damages correctly if: $I(r^b,r^s,\theta) = T^o - r^s - C(r^b,\theta,\eta(r^b,r^s,\theta)), \forall\theta$ holds. In fact, the seller would then be awarded with correct expectation damages, at least along the equilibrium path.

As our next Proposal shows, reflecting the correct expectation damages comes at a cost. In light of Slogan 3, while it may still be feasible to provide efficient reliance incentives, the solution will typically fail to be *ex post* efficient.

Definition 2*:* To be efficient, any mechanism must satisfy (a) the participation constraints [IR]; and meet (b) the incentive constraints [IC].

The process: Suppose the transfer schedule $T(r^b,r^s,m,q)$ gives rise in equilibrium to the performance choice $\eta(r^b,r^s,\theta)$ and the transfer payment $\tau(r^b,r^s,\theta)$. Notice that disallowing a certain performance q is equivalent to setting $T(r^b,r^s,m,q) = +\infty$, and since the agent always has an option to reject the tariff without loss of generality, we constrain the Principal to offer $T(r^b,r^s,m,q=0)=0$, and assume that the agent always accepts. Thus, the contractual form of tariff is quite general, and as we will later see, we lose nothing by restricting attention to this form of contract. Thus, $\forall\theta,\theta'\in\Theta$ following two inequalities must hold:

[IR]: $\tau(r^b,r^s,\theta)-r^s-C(r^s,\theta,\eta(r^b,r^s,\theta))\geq C(r^s,\theta,q=0)$

And

[IC]: $\tau(r^b,r^s,\theta) - r^s - C(r^s,\theta,\eta(r^b,r^s,\theta))\geq\tau(r^b,r^s,\theta') - r^s - C(r^s,\theta,\eta(r^b,r^s,\theta'))$

i.e. $\tau(r^b,r^s,\theta')-\tau(r^b,r^s,\theta)\geq C(r^s,\theta,\eta(r^b,r^s,\theta))-C(r^s,\theta,\eta(r^b,r^s,\theta'))$[10].

10 (IR) stands for the familiar Individual Rationality or Participation constraints. The (IR) inequality reflects the fact that the agent of type θ has the option of choosing performance $\eta(r^b,r^s,\theta) = 0$, i.e., rejects the tariff, but prefers to choose $\eta(r^b,r^s,\theta)$ which is meant for his type. The (IC) stands for incentive-compatibility or self-selection or truth telling. The inequalities (IC) show that the agent of type θ has the option of choosing $\eta(r^b,r^s,\theta')$, which is the equilibrium consumption of type θ', but prefers to choose $\eta(r^b,r^s,\theta)$.

Now let's consider a different mechanism in which the principal asks the agent to make an announcement θ' and then supplies the agent with the quantity $\eta(r^b,r^s,\theta')$ in exchange for the payment $t(.,\theta')$. Since the inequalities (IC) are satisfied, each agent will prefer to announce his true type $\theta'=\theta$, rather than lie. Since the (IR) inequality is satisfied, each type of agent will accept this mechanism.

Before proceeding further, using definition 2, we derive the following slogan:

Slogan 4: If SCP is met for $W(.,q,\theta)$ then, by construction, the negative of the seller's cost i.e. $[-C(.,q,\theta)]$ also satisfies SCP. Then, for all $\theta,\theta'\in\Theta$, the seller's IC requires that:

$$C(r^s,\theta,\eta(r^b,r^s,\theta)) - C(r^s,\theta',\eta(r^b,r^s,\theta)) \leq I(r^b,r^s,\theta') - I(r^b,r^s,\theta)$$

$$\leq C(r^s,\theta,\eta(r^b,r^s,\theta')) - C(r^s,\theta',\eta(r^b,r^s,\theta')).$$

Moreover, if $\theta<\theta'$ then $\eta(r^b,r^s,\theta)\leq\eta(r^b,r^s,\theta')$ i.e. the equilibrium performance choice is a monotonically increasing function for private information.

Proof: Since the message sent by the informed party maximises his payoff, for a given level of reliance investments and a θ we have:

$$I(r^b,r^s,\theta) = T(r^b,r^s,m_s(r^b,r^s,\theta),q_B(r^b,r^s,m_s(r^b,r^s,\theta))) - C(r^s,\theta,q_B(r^b,r^s,m_s(r^b,r^s,\theta)) - r^s$$

$$= \tau(r^b,r^s,\theta) - C(r^s,\theta,\eta(r^b,r^s,\theta)) - r^s$$

$$\geq T(r^b,m_s(r^b,r^s,\theta,q_B(r^b,r^s,m))) - C(r^s,\theta,q_B(r^b,r^s,m)) - r^s \quad \textbf{(21)}$$

must hold for any other message $m\neq m_s(.)$; $\forall\, m,m_s\in M$. In particular, this must be true for the message $m=m_s(r^b,r^s,\theta')$ that the seller would have sent in equilibrium after obtaining private information θ'. Therefore:

$$I(r^b,r^s,\theta) \geq T(r^b,r^s,m_S(r^b,r^s,\theta'),q_B(r^b,r^s,m_S(r^b,r^s,\theta'))) - C(r^s,\theta,q_B(r^b,r^s,m_S(r^b,r^s,\theta')) - r^s$$

$$= \tau(r^b,r^s,\theta') - C(r^s,\theta,\eta(r^b,r^s,\theta')) - r^s$$

from which the second inequality of the slogan follows easily.

The first inequality follows from a similar argument, where the true information is θ' but the informed party has revealed θ instead. Moreover, the monotonicity of performance choice as a function of private information follows from the single-crossing property -assumption (e)- and the two inequalities have just been established.

Proposal 4: Let´s suppose assumptions (a),(b) and (e) are met. If the transfer schedule $T(r^b,r^s,m,q)$ reflects correct expectation damages along the equilibrium path, then the seller will meet her obligation, i.e. $\eta(r^b,r^s,\theta)\equiv q^o$ even if it were efficient to breach. Moreover, the buyer has the incentive for reliance investments: $r^b\in \arg\max_{r^b\in R}[V(r^b,q^o)-T^o-r^b]$, and the seller has the incentive for reliance investments: $r^s\in \arg\max_{r^s\in R} E_\theta[T^o-C(r^s,\theta,q^o)-r^s]$, which are efficient under a contract stipulating $q^o=q^{oo}(if\ q^{oo}\ exists)$.

Proof: Let $\theta^o = sup\{\theta\in \Theta:\eta(r^b,r^s,\theta)\leq q^o\}$ under which the performance choice does not exceed the quantity specified in the contract. From the monotonicity established in Slogan 3 follows that for any $\theta<\theta^o$, we have $\eta(r^b,r^s,\theta)\leq q^o$.

Moreover, if $\theta'<\theta''<\theta^o$, then we have:

$$C(r^s,\theta',\eta(r^b,r^s,\theta'))-C(r^s,\theta'',\eta(r^b,r^s,\theta'))\leq C(r^s,\theta',q^o)-C(r^s,\theta'',q^o)$$

$$\leq C(r^s,\theta',\eta(r^b,r^s,\theta''))-C(r^s,\theta'',\eta(r^b,r^s,\theta''));$$

because, in this range of information parameters, the seller's payoff is the same as if the buyer had met his obligation. Then, from SCP $\eta(r^b,r^s,\theta')\leq q^o\leq\eta(r^b,r^s,\theta'')$ must hold for any two information parameters $\theta'<\theta''<\theta^o$.

For any $\theta<\theta^o$, consider two information parameters $\theta'<\theta<\theta''<\theta^o$ from this range and apply the findings from above in pairs. In particular, $\eta(r^b,r^s,\theta')\leq q^o\leq\eta(r^b,r^s,\theta)$ and $\eta(r^b,r^s,\theta)\leq q^o\leq\eta(r^b,r^s,\theta'')$ must both hold, from which it follows that $\eta(r^b,r^s,\theta)=q^o$ must be constant over the range (θ_L,θ^o).

Next, consider information parameters from the range $\theta^o<\theta<\theta_H$. For such parameters, $q^o<\eta(r^b,r^s,\theta)$ must hold as follows from the monotonicity of the equilibrium performance choice. Furthermore, in this range, the net payoff of the seller would be amounting to:

$$I(r^b,r^s,\theta)=T^o-C(r^s,\theta,\eta(r^b,r^s,\theta))-r^s,$$

which, combined with the IC from Slogan 3, is leading to

$$C(r^s,\theta',\eta(r^b,r^s,\theta'))-C(r^s,\theta'',\eta(r^b,r^s,\theta'))\leq C(r^s,\theta',\eta(r^b,r^s,\theta''))-C(r^s,\theta'',\eta(r^b,r^s,\theta'))$$

$$\leq C(r^s,\theta',\eta(r^b,r^s,\theta''))-C(r^s,\theta'',\eta(r^b,r^s,\theta')),$$

for any two information parameters in the range $\theta^o<\theta'<\theta''<\theta_H$ and, hence, to $C(r^s,\theta'',\eta(r^b,r^s,\theta'))\geq C(r^s,\theta',\eta(r^b,r^s,\theta''))$ and $C(r^s,\theta',\eta(r^b,r^s,\theta''))\geq C(r^s,\theta',\eta(r^b,r^s,\theta'))$.

It then follows from the monotonicity of utility as a function of performance choice –assumption (d)–, that equilibrium performance choice $\eta(r^b,r^s,\theta')=\eta(r^b,r^s,\theta'')=q'$ will be constant in this range as well.

Consider finally an information parameter $\theta<\theta^o<\theta'$ from each range. From the monotonicity of performance choice results that: $\eta(r^b,r^s,\theta) = q^o \leq \eta(r^b,r^s,\theta') = q'$; and from the incentive constraints we have that:

$$I(r^b,r^s,\theta') - I(r^b,r^s,\theta) = C(r^s,\theta,q') - C(r^s,\theta',q^o)$$

$$\leq C(r^s,\theta,\eta(r^b,r^s,\theta')) - C(r^s,\theta',\eta(r^b,r^s,\theta')) = C(r^s,\theta,q') - C(r^s,\theta',q^0); \quad \textbf{(22)}$$

and, hence, $C(r^s,\theta,q') \geq C(r^s,\theta,q^o)$ must hold. By using the monotonicity of utility as a function of performance choice, $q^o=q'$ must hold. Proposal 4 is proved.

Let's recall from the previous section that, under suitable differentiability, q^{oo} will exist if performance choice is continuous. If, however, performance choice is binary, then under-investment and over-investment would result from a contract, specifying $q^o=q_L$ and $q^o=q_H$, respectively, as follows from Slogan 3.

CPI Environment: Even if investments are a hidden action,the next proposal shows a transfer schedule $T^*(m,q)$ exists, which leads to the first best solution. But, by Proposal 4, the efficient transfer schedule $T^*(m,q)$ cannot reflect expectation damages correctly.

Proposal 5: A message space M and a transfer schedule $T^*(m,q)$ exist that lead, in equilibrium, to the first best solution.

The proof of Proposal 5 is quite intuitive and thus omitted. The efficient price schedule will be based on the direct incentive compatible mechanism.

Remarks: To conclude this subsection, let us briefly compare the present findings, derived under asymmetric information, with those that would hold if the information parameter could be verified and, hence, correct damages, which according to equation (19) could be administered by courts. Let's suppose that the assumptions (a) and (e) are met. If the contract specifies high performance $q^o=q_{H,}$ then the seller has the incentive to take the socially best response as his performance choice and *ex post* efficiency would be ensured; yet, both will face excessive incentives for reliance investments as follows from Slogan 3 and equation **(18)**.

If, at the other extreme, the contract specifies low performance $q^o=q_L$, then the buyer would stick to the contract. If such an outcome is anticipated under complete information, the parties would be able to renegotiate to a performance choice that is *ex* *post* efficient. Since the buyer would obtain only a fraction of let´s say half of the renegotiation surplus, his incentives for reliance would be suboptimal. In a similar way, as the seller anticipates *ex post* efficient performance through renegotiation, thus her investment would be optimal.

In Shavell's setting of binary performance choice, only the high performance contract is available (the low performance contract would be equivalent to no contract) and would provide the buyer with excessive incentives for reliance investments. In the Edlin and Reichelstein setting of continuous performance choice, however, intermediate levels of performance choice exist that would provide efficient reliance incentives. In this sense, Shavell'sover-reliance result is due to binary performance choice and not to a basic defect of expectation damages. In the SB case, assessing exact expectation damage is not only difficult, but comes at a price in terms of efficiency loss.

3.3.2. Case SS: Seller Obtains Private Information and also Considers Breach

This case is similar to the model we have been originally dealing with in a binary performance choice framework. After having obtained her private information, the seller may announce that she is only going to deliver a quantity $q \leq q^o$. Since, at the time of performance, the seller chooses to deliver $q \leq q^o$ and breaches for rest of the quantity, then following the expectation damage rule, she owes damages $D(r^b,q)=max[V(r^b,q^o) - V(r^b,q);0]$ to the buyer. This compensation then makes the buyer at least as well off as if the seller had met her obligation. More precisely, if $V(r^b,q^o) - V(r^b,q) \geq 0$ then he would be exactly as well off, well in line with expectation damage remedy; whereas otherwise, in case $V(r^b,q^o) - V(r^b,q) < 0$, he even enjoys a windfall gain from the seller's neglect of her obligation. Common legal practice allows the buyer to keep such windfall gains for free. Since the buyer does not obtain private information, such damages can be verified in front of a court, provided reliance investments are observable.

The seller's payoff amounts to: $\Psi(r^b,r^s,\theta,q)=T^o - C(r^s,\theta,q) - r^s - max[V(r^b,q^o) - V(r^b,q),0]$.

Thus the seller chooses the performance according to: $q_S(r^b,r^s,\theta) \in \arg\max_{q \in Q} \Psi(r^b,r^s,\theta,q)$.

We now segregate the two possible cases according to the values that damage remedy can take, and treat them separately for analytical results and a definite conclusion.

First.– If $D(r^b,q) \neq 0$: If the contract specifies a delivery choice q^o such that windfall gains to the buyer will never arise, then the seller's payoff would be

$$\Psi(r^b,r^s,\theta,q)=[V(r^b,q)-C(r^s,\theta,q)-r^s\ -r^b]+[T^o\ -V(r^b,q^o)+r^b]\ =\ W(r^b,r^s,\theta,q)+[T^o$$

$$-V(r^b,q^o)+r^b]$$

Which depends for the first term on actual performance choice and is equal to the social surplus. Hence, the seller makes the performance decision as follows

$$q_s(r^b,r^s,\theta)\in \arg\max_{q\in Q}\ \Psi(r^b,r^s,\theta,q) = \arg\max_{q\in Q}\ W(r^b,r^s,\theta,q)$$

which coincides with the socially best response performance choice i.e. $q^{+}(r^b,r^s,\theta)$.

If the seller announces breach $q\leq q^o$, upon receiving the expectation damage, the buyer's payoff would be:

$$\Phi(r^b,r^s,\theta,q)\ = V(r^b,q) -T^o -r^b+[V(r^b,q^o) -V(r^b,q)]$$

$$= [V(r^b,q^o) -C(r^s,\theta,q^o) -r^b -r^s] -[T^o -C(r^s,q^o) -r^s]= W(r^b,r^s,\theta,q^o)+[C(r^s,q^o)+r^s -T^o]$$

and is, until the first term, independent of actual performance and equal to social surplus, corresponding to the initial contractual quantity choice q^o which does not depend on *ex post* actual state-contingent performance choice by the seller.

Anticipating such a payoff at the investment stage, the buyer would have the incentive for reliance, as:

$$r_E^b\ \in \arg\max_{r^b\in R}\ E_\theta[\Phi(r^b,r^s,\theta,q^o)] = \arg\max_{r^b\in R}\ E_\theta[W(r^b,r^s,\theta,q^o)]$$

$$\neq \arg\max_{r^b\in R}\ E_\theta[W(r^b,r^s,\theta,q^{+}(r^b,r^s,\theta))]=r^{b*}$$

would hold.

As a consequence, the buyer would have the incentive to choose a level of reliance which is higher than the socially optimal level, unless and until, in the light of Slogan 3, the initial contractual quantity $q^o=q^{oo}$ would be an efficient investment for the buyer. Given the buyer's investment choice r_E^b, anticipating this, the seller would then choose her investment level according to:

$$r_E^s \in \arg\max_{r^s\in R} E_\theta[\Psi(r_E^b\ ,r^s,\theta,q^{+}(r^b,r^s,\theta))] = \arg\max_{r^s\in R} E_\theta[W(r_E^b\ ,r^s,\theta,q^{+}(r^b,r^s,\theta))]$$

$$\neq \arg\max_{r^s\in R} E_\theta[W(r^b,r^s,\theta,q^{+}(r^b,r^s,\theta))]=r^{s*}.$$

And hence, she would have an incentive to rely higher than the socially best level, which crucially depends upon the buyer's reliance choice, as the seller has to fully internalise the cost of breach under expectation damage remedy.

In this case, in the light of Slogan 3, the first best solution can be implemented by just requiring the parties to specify a suitable initial contractual quantity choice $q^o = q^{oo}$, and for the seller to mitigate damages, as per actual expectancy of the buyer results from breach.

Second.– If $D(r^b,q) = 0$: Then the seller's payoff would be

$$\Psi(r^b,r^s,\theta,q) \; = T^o - C(r^s,\theta,q) - r^s = [V(r^b,q) - C(r^s,\theta,q) - r^b - r^s] + [T^o - V(r^b,q) - r^b]$$

$$= W(r^b,r^s,\theta,q) + [T^o - V(r^b,q) - r^b].$$

And hence she will breach whenever her *ex post* cost (net of investment) is higher than the contractual price. Now the buyer's payoff in this case is

$$\Phi(r^b,r^s,\theta,q) \; = V(r^b,q) - T^o - r^b = [V(r^b,q) - C(r^s,\theta,q) - r^b - r^s] - [T^o - C(r^s,\theta,q) - r^s]$$

$$= W(r^b,r^s,\theta,q) + [C(r^s,\theta,q) + r^s - T^o].$$

Note that since both the parties' payoffs up to the first term in their respective expressions above are dependent on the *ex post* actual performance choice, both of them (automatically) undertake socially efficient investments which can easily be shown.

Such practice introduces a direct and efficient mechanism, which is incentive compatible and works even if investments are a hidden action. Under this mechanism, the informed party (seller) is directly asked to reveal his private information. This direct mechanism is of the Clarke-Groves type. We shall indirectly demonstrate this mechanism in the next liquidated damage subsection (4), examining it in a concrete setup.

4. Party Designed Liquidated Damage

The buyer and the seller in this case can keep a provision for a breach of contract by including a liquidated damage clause in their contract agreement. There could be three different contracting scenarios to provide a diverse range of environments for analysis. First, the buyer may propose a contract to the seller, and the seller may accept or reject it. Second, the seller proposes a contract, and the buyer accepts or rejects it. Finally, an uninformed broker may design a contract that maximises the joint surplus from the trade between parties. Taking the usual route in contract theory literature, the uninformed party −here the buyer− designs the contract. We now study the impact of this remedy.

The sequence of events:

The parties at Time 1 sign a contract and specify the fixed delivery price p and the liquidated damage payment, D_L → Between Time 1 and Time 2, both the buyer and the seller make reliance investments of r^b, $r^s>0$, given p and D_L → at Time 2, the seller observes his cost of production → given p and D_L, the seller decides whether to perform the contract or breach the contract → If the seller breaches, the buyer files a lawsuit and the court awards him the liquidated damages D_L at Time 3.

The seller's breach decision is subjected to her realised cost, and contractually agreed p and D_L. The seller will perform only when: $p - c \geq -D_L$ or if: $c \leq p + D_L$.

For further reference, it is useful to define T as the sum of the price and the liquidated damage clause: $T \equiv p+D_L$. We will refer to T as the promisor's "total breach cost" when leaving the existing contract, consisting of his opportunity costs p and the damage D_L.

Thus, the probability of performance by the seller is:

$$Pr[C(r^s)+\theta \leq p+D_L]=Pr[\theta \leq p+D_L-C(r^s)]=F[p+D_L-C(r^s)].$$

Given the probability performance, the buyer's expected payoff is:

$$EP_L^{\ b} = F[p+D_L - C(r^s)].[V(r^b) - p]+\{1 - F[p+D_L - C(r^s)]\}.D_L - r^b \qquad \textbf{(23)}$$

And the seller's expected payoff is:

$$EP_L^{\ s} = F[p+D_L - C(r^s)].[p - E(c|\ c \leq p+D_L)]+\{1 - F[p+D_L - C(r^s)]\}.(-D_L) - r^s$$

$$= F[.].(p+D_L) - F[.].E(C(r^s)+\theta|C(r^s)+\theta \leq p+D_L) - D_L - r^s. \qquad \textbf{(24)}$$

Thus, we obtain the following slogan:

Slogan 5: For any given $T \equiv p+D_L$, $p>0$, the buyer can always benefit by increasing D_L and decreasing p by the same amount, thereby keeping T constant.

Proof: Simply note that the buyer's expected payoff can also be written as:

$$EP_L^{\ b}=F[T - C(r^s)].V(r^b)+D_L - F[T - C(r^s)]\}.T - r^b$$

which is strictly increasing in D_L .

The slogan implies that, for the given T, the buyer prefers to offer a price p as low as possible to the seller. Although p and D_L are prefect substitutes from the standpoint of contract performance, the buyer prefers to obtain a higher damage payment D_L rather than paying a higher price p. Clearly, there is a limit to lowering p due to the non-negativity constraint and the seller's participation requirement.

We assume that the buyer has all the bargaining power in contracting; i.e., he makes a "take it or leave it" offer to the seller. The seller can accept or reject the contract. If the seller rejects it, the outcome is $(q,p)=(0,0)$. This is the seller's reservation bundle and her reservation utility thus be $c=0$, as there is no market alternative. Since the buyer determines p and D_L to maximise his expected payoff[11].

However, we have the following optimisation problem

$$\max_{p,D_L,r^b,r^s} EP_L^b(p,D_L,r^b)$$

Subject to (i) $EP_L^s \geq 0$ [IR] and (ii) $\max_{r^s} EP_L^s$ [IC]

Besides, the seller's maximisation problem gives us the following F.O.C.

$$f(.)[-C'(r^s)](p+D_L) - f(.)[-C'(r^s)](p+D_L) + F(.).[-C'(r^s)] = 1$$

$$\Rightarrow F[p+D_L - C(r^s)].C'(r^s) = -1 \quad \textbf{(25)}$$

Replacing this into the buyer's maximisation problem, we rewrite the problem as follows −

$$\max_{p,D_L,r^b,r^s} EP_L^b(p,D_L,r^b)$$

subject to (i) $EP_L^s \geq 0$ [IR]

(ii) $F[p+D_L - C(r^s)].C'(r^s) = -1$ [IC]

The buyer, by assumption, has entire bargaining power and thus extracts entire *ex ante* surplus; which entails that the participation constraint is binding in light of Slogan 5.

Therefore, we derive the following slogan

11 Under asymmetric information, the principal cannot observe the agent's effort. Thus the buyer's program is then to offer the seller a contract (*p, DL*) that will maximise his expected payoff subject to the IC and an IR of the seller, so that the seller gets a non-negative utility.

Slogan 6:

$$p^{*}+D_L^{*}=V(r^{b*}) \quad \textbf{(26)}$$

$$D_L^{*}=F[(V(r^{b*})-C(r^{s*})].\{V(r^{b*})-E(c \mid c \leq V(r^{b*}))\}-r^{s*}$$

$$p^{*}=\{1-F[(V(r^{b*})-C(r^{s*})]\}.V(r^{b*})+F[(V(r^{b*})-C(r^{s*})].E[c \mid c \leq V(r^{b*})]+r^{s*}$$

$$EP_L^{b}=D_L^{*}-r^{b*}$$

$$EP_L^{s}=0 \ .$$

Slogan 7: Both the parties undertake the socially desired level efficient investment under liquidated damage remedy when one-sided private information is present.

Slogan 6 & 7 Proof: We provide a joint proof for both slogans since they are inter-linked with each other. Substituting IR into the objective function we get

$$F(.)V(r^{b})-F(.)E[C(r^{s})+\theta|C(r^{s})+\theta \leq p+D_L]-r^{b}-r^{s} \quad \textbf{(27)}$$

Now replacing IC into the previous expression, we rewrite it as

$$-[1/C'(r^{s})].V(r^{b})+[1/C'(r^{s})].E[C(r^{s})+\theta|C(r^{s})+\theta \leq p+D_L]-r^{b}-r^{s}$$

Maximising the expression just above w.r. to r^{b} results in the following

$$-[1/C'(r^{s})].V'(r^{b})=-1 \text{ or, } V'(r^{b*})=C'(r^{s*}) \quad \textbf{(28)}$$

⇒ The marginal returns from reliance investments by the parties are equal.

Now, maximising the expression **(27)** w.r. to r^{s} is

$$f(.).[-C'(r^{s})].V(r^{b})-f(.).[-C'(r^{s})].(p+D_L)-F(.).[-C'(r^{s})]-1=0$$

$$\Rightarrow f(.).C'(r^{s}).[V(r^{b})-(p+D_L)]=0, \text{ [since from (IC)}, F(.).C'(r^{s})=-1]$$

$$\Rightarrow V(r^{b*})=(p^{*}+D_L^{*}), \text{ [since } f(p+D_L-C(r^{s}))\neq 0] \quad \textbf{(29)}$$

⇒ The optimum total breach cost is equal to the optimum buyer´s valuation.

$$\Rightarrow r^{b*}=V^{-1}(p^{*}+D_L^{*})$$

Putting $p^*$and D_L^* into the seller's payoff function, we get the seller's equilibrium payoff:

$$EP_L^{s*} = F(p^*+D_L^*- C(r^{s*})).[p^* -E(c \mid c \leq V(r^b))]+[1 -F(p^*+D_L^*- C(r^{s*}))](-D_L^*) -r^s$$

When we set EP_L^{s*}=0, then

$$p^*=[1 -F(V(r^{b*})- C(r^{s*}))].V(r^b)+F(V(r^{b*})- C(r^{s*})).E(c \mid c \leq V(r^{b*}))+r^{s*} \quad \textbf{(30)}$$

Thus

$$D_L^*=F(V(r^{b*})- C(r^{s*})).\{V(r^{b*}) -E(c \mid c \leq V(r^{b*}))\} -r^{s*} \quad \textbf{(31)}$$

Therefore, the buyer's equilibrium payoff:

$$EP_L^{b*} = F(p^*+D_L^*- C(r^{s*}))[V(r^{b*}) -p^*]+[1 -F(p^*+D_L^*- C(r^{s*}))]D_L^* -r^{b*}$$

$$= F(p^*+D_L^*- C(r^{s*})).[p^*+D_L^* -p^*]+[1 -F(p^*+D_L^*- C(r^{s*}))]D_L^* -r^b$$

$$=D_L^* -r^{b*} \quad \textbf{(32)}$$

Note: So long as the buyer's valuation is observable, the breach cost T=v is the unique optimum. The equivalent contract price offered by the buyer is p, which just satisfies the seller's reservation price. Similarly, if the seller has all of the bargaining power, she will maximise profits subject to the buyer's acceptance of terms (i.e., $EP_L^b \geq 0$), which is identical to the buyer's program above, and so we again find T=v. However, the price-paid by the buyer to the seller under this scheme is p=v, which extracts the entire buyer's rent.

Finally, if a broker proposes a contract to the parties, the broker will maximise the expected profits from trade by choosing T to maximise the collective surplus $EP_L^J(v,T,c)$. Again the solution is to set T=v. The broker then chooses a price to allocate the profits from trade with p lying in the interval $[v,E(c)]$. It is not surprising that the optimal full-information contract specifies T=v for each contracting environment, since this condition guarantees that breach occurs if and only if it is efficient.

Conclusion

Legal proceedings both in Common Law and Civil Law countries in an asymmetric information environment seem to be relying on two remedies: First, taking resort in objectifying damage measures and second, some legal systems allow the promisee to choose recovery of reliance expenditures instead of expectation damages. The choice was introduced for promisees that have difficulties verifying their true expectation damages in front of a court. However, both are defective. In the first case, it neither assesses expectation damages correctly nor does it provide incentives for an efficient breach. In the case of reliance damages, the outcome, again, cannot be state-contingent and, hence, the *ex post* efficiency will not be achieved.

We find that in case of bilateral investments, both the reliance and the restitution remedies lead to inefficient outcomes (both in breach and in reliance) for fixed-price incomplete contracts. With no damage measure, in case the promisee undertakes reliance, she would over-rely in specific assets, whereas the promisor would under-rely. When the remedy choice is reliance damage, the general result we found across the board is that it leads the promisee to over-rely and the promisor to rely less compared to their respective efficient reliance levels. Both of these remedies result in frequent breach by the promisor; since reliance damages also lead to an effective transfer schedule $T(r^b,q)$ that does not depend on nature's move, and therefore *ex post* efficiency would not be restored.

Finally, when expectation damage can be assessed by court properly and are in fact awarded, first, it ensures efficient performance and second, it induces efficient reliance for the breaching promisor (if at all she invests) but leads the promisee to over-rely. This result holds well, irrespective of the situation, whether selfish reliance is undertaken unilaterally or bilaterally. In case of a reliance setting with hidden information, our analysis has categorically established that a trade-off exists between providing efficient incentives and assessing expectation damages correctly. Provisions that would allow assessing expectation damages correctly prevent efficient breach of contract, whereas revelation mechanisms leading to the first best solution would fail to assess damages correctly.

To sum up, pragmatic solutions of awarding damages under asymmetric information seem defective on two accounts. First, they fail to assess expectation damages correctly. If granted such damages, the promisee needs not to be equally well off as if the promisor had met his obligation. Second, the outcome will be constant over states and, as such, will typically fail to be *ex post* efficient.

In the words of Korobkin and Ulen (2000), "Legal rules create incentives or disincentives for actors subject to the legal system to act. Thoughtful legal policy must recognise these incentive effects and be responsive to them". Since the revelation mechanisms that would generate the first best solution are available, at least for the present setting, such legal practice are not justified from the economic perspective. Instead, the adoption of liquidated damage remedies should be encouraged.

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