Rethinking the Economic Characteristics of the Major Contractual Damages[*]

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<ABSTRACT>

We clarify the conventional claims concerning the most popular damage measures: expectation damages (ED), constant damages (CD), and reliance damages (RD). We strictly examine 'strategies vs. outcomes' in equilibrium and several attempts are newly made. In terms of equilibrium outcomes, we obtain results that contrast with the existing claims. The results particularly worth noting are: First, ED always results in over-performance. Second, CD, in general, does not warrant efficient reliance. Third, over-breach need not be realized under RD. Overall, this paper also delivers a message that the simultaneity in contract games is more important than has been traditionally treated in the literature.

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I. Introduction

This paper, by way of synthesis, probes on generic conditions for the optimal damage measure in contracts, and, based on the conditions, examines the efficiency of the various damage schemes that primarily have been discussed in the literature. Contracts are often broken because of uncertain contingency, for instance, the prohibitively large costs of implementing the contract as promised. Thus, varying assessments across parties, regarding who is responsible for the breach and how much damages should be paid to the victim, will inevitably bring the court as an umpire into the game situation. Ever since formal analyses of damage measures was fully launched in the early 1980s, many have examined the optimality natures of various measures; the most important among them might be expectation damages (**ED**, hereafter), constant damages (**CD**, hereafter), and reliance damages (**RD**, hereafter). Regarding these three measures, there are widely-accepted propositions, which are 1) "ED induces efficient breach given reliance,"[1] 2) "CD induces efficient reliance,"[2] and 3) "RD induces over-breach."[3] However, as we show in this paper, these well-known propositions

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[1] See, among others, Shavell (1980, p. 478), Shavell (1984, pp. 133-134), Rogerson (1984, p. 47), Ulen (1984, pp. 362-363), Cooter (1985, pp. 17-18), Craswell (1989, p. 371), Miceli (1997, p. 73), Bebchuk and Png (1999, p. 324), Mahoney (2000, p. 122), Polinsky (2003, pp. 33-35), Hermalin et al. (2007, pp. 102-103), Posner (2007, p. 121), and Cooter and Ulen (2008, p. 316). The efficiency feature of ED regarding the promisor's incentive, however, is claimed sometimes without the 'given reliance' condition.

[2] See, for example, Shavell (1980, pp. 480-481), Cooter (1985, p. 18), Cooter and Eisenberg (1985, p. 1467), Miceli (1997, pp. 74-75), Polinsky (2003, pp. 38-39), Hermalin et al. (2007, p. 107), and Cooter and Ulen (2008, p. 319). Some of these (i.e., Shavell, Miceli, and Polinsky) did not discuss CD 'in general' but analyzed only its subset such as 'no damages' or 'restitution.' CD also includes liquidated damages and perfect expectation damages which will be discussed later in Section IV.

[3] In the literature, RD has been characterized as inducing over-reliance and over-breach; see, for instance, Shavell (1980, pp. 479-480), Ulen (1984, pp. 358-359),

seem to involve some misperceptions that need clarifications.

Specifically, we focus on two major sources of misperceptions of the extant literature: (i) the sequence of moves and information structure; (ii) the concept of efficiency. The first issue, (i), concerns the tendency not to distinguish strictly between *sequential vs. simultaneous* contracts. Although most analyses assume sequential settings, in reality there are many situations that would fit a simultaneous setting better especially when the promisor makes the breach decision without knowing about reliance. From this point of view, *Security Stove & Mfg. Co. v. American Ry. Express Co.* [App. 175, 51 S.W.2d 572 (1932)] of the US, for instance, merits elaboration. The promisee wanted a stove shipped in 22 packages for an exhibition, and entered into a contract with a shipping company, the promisor. Relying on the contract the promisee underwent various expenses (for the exhibition booth, traveling, employment etc.) to prepare for the exhibition. However, the promisor, 'without knowing' the total amount of the promisee's expenditure, breached: The most critical package was not delivered.[4]

Suppose that ED is applied to the above case. ED was usually analyzed through sequential-move games such that the promisor decides on breach with the knowledge of the promisee's reliance level. Nonetheless, the aforementioned cases are of simultaneous moves as the promisor breaches 'without' observing the promisee's reliance (just as the bilateral-precaution models of tort typically

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Rogerson (1984, pp. 47-49), Miceli (1997, p. 74), Mahoney (2000, pp. 122-123), Polinsky (2003, pp. 34-35, 38), and Hermalin et al. (2007, p. 106).

[4] A famous case, *Hadley v. Baxendale* [9 Exch. 341 (1854)] appears to fit a simultaneous-game setting, too, according to judgments such as "… if these special circumstances **were wholly unknown** to the party breaking the contract, he, at the most, could only be supposed to have had in his contemplation the amount of injury which would arise generally …" (emphasis added). Similar features can be inferred from *L. Albert & Son v. Armstrong Rubber Co.* [178 F.2d 182 (2d Cir. 1949)] and numerous others.

presume).[5] In reality, such contractual situations certainly abound. Is the well-known claim, 1) above, then still valid where the 'given reliance' condition is simply unavailable? Should courts not take into account this simultaneous-move nature for their judicial policy? We claim that the prevailing concept of 'sequential efficiency' is not really relevant in such cases. For example, there is 'always over-performance' under ED in case of simultaneous-move games. We will show that similar complexities are found in the widely-accepted claims associated with CD and RD.

In fact, Bebchuk and Png (1999) are the first who seriously recognized this issue.[6] They, based on the (simultaneous) precaution model of Cooter (1985), clearly distinguished between 'unobserved' (i.e., simultaneous) and 'observed' (i.e., sequential) reliance in order to derive different assessments of representative damage measures. We immediately highlight that this important attempt appears to have been under-appreciated in the literature. Indeed, their analytic results overall are identical to part of this paper's. However, their work is not without a blemish in terms of what we plan to pursue overall in this paper. As we explain respectively later, owing possibly to the lack of a formal game-theoretic framework, some of their illustrations are unclear and the results are partly incorrect.

Next, misunderstandings related to the second issue, (ii), are due to the lack of

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[5] Our casual observation has long been that, in the field of law and economics on civil laws, sequential models are dominant with respect to contract law, while simultaneous models are overwhelming in tort law. However, many judges and lawyers are telling us that, in real-world disputes, the promisee's reliance often is 'unobservable at all' and, by contrast, the injurer's precaution often is determined after 'correctly observing' the victim's. In this regard, this paper will hopefully allude to the importance of the simultaneity in the contract game.

[6] Emons (1991) also was aware of the importance of game sequences in contracting, although his major subject therein did not bear significant relevance to the current paper.

a clear-cut distinction between the *equilibrium strategy* and the *equilibrium outcome*. Even though the efficiency of a damage measure could and often should be evaluated on the basis of 'realized outcome,' confusions are found in the literature as it is mostly discussed only in terms of each player's 'strategy' in equilibrium. Let us take up ED again. The proposition of efficient breach 'given reliance' has been derived from the confirmation that the promisor's reaction curve is identical to that of the social optimum. It is then correct in the context of *equilibrium strategy* to state that the breach decision is efficient 'given reliance.' However, it by no means warrants the actual realization of efficient breach as an *equilibrium outcome,* because the equilibrium outcome is jointly determined by *both* parties, not just by the promisor alone.

Indeed, over-performance (i.e., inefficiency) does 'always' result as an equilibrium outcome even if the promisor's strategy can be interpreted to be sequentially efficient under ED. Thus, the existing proposition on the promisor's breach decision is alluding merely to the so-called 'sequential efficiency,' not the 'final outcome' that we attain. Yet, we believe that the final outcome can be more important in assessing the performance of ED. We argue that this distinction is utmost important especially from the standpoint of judicial policy. Equilibrium outcome – rather than strategy – should usually be more relevant for evaluating competing legal institutions.[7]

With these motivations, we apply simple game-theoretic analyses to the three major measures. Upon making clear distinctions between 'simultaneous and

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[7] This second confusion is found in CD and RD, too, as shown later. The general propositions above, 2) and 3), again are interpretations merely based on the player's reaction function. As for CD, efficient reliance cannot be warranted unless the given probability of performance is determined perfectly. Equally, over-performance can be readily realized *ex post* under RD if the given reliance is fairly excessive.

sequential' models in each, we examine 'strategies vs. outcomes' in equilibrium. Section II sets up a basic model and derives socially optimal equilibrium. ED, CD, and RD are investigated in Sections III, IV, and V, respectively. Several analyses are newly attempted, too. For instance, the equilibrium characteristics, under RD, of the promisor's breach side in 'simultaneous games' and also the equilibrium outcome in 'sequential games' are identified for the first time. Furthermore, we obtain interesting results on the equilibrium outcome that contrast with the existing claims. The results particularly worth noting are as follows. First, ED always results in over-performance. Second, CD, in general, does not warrant efficient reliance. Third, over-breach need not be realized under RD. Finally, Section VI analyzes some meaningful non-standard value function cases, and Section VII concludes the discussions.

II. The Model and Social Optimum

1. The Basic Model

Consider a bilateral contract as follows. The promis**e**e (**Pe**, hereafter) contracts to purchase a good from the promis**o**r (**Po**, hereafter).[8] **Po** is obliged to produce and deliver the good at some specified future date. The value of the good to **Pe** is denoted by $V(r)$, where r is **Pe**'s investment in reliance made after the contract is signed. It is assumed that the V function is known publicly with $V'(r) > 0$ and $V''(r) < 0$.[9] However, r has no salvage value in the event of non-performance.

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[8] The basic setting is almost identical to Miceli (1997) which was based largely on Shavell (1980).

[9] This is the standard assumption adapted in most literature. However, in reality, there can also be other cases where the value function is not concave from the origin. We will analyze some meaningful non-standard value functions in Section VI.

We assume some uncertainty over **Po**'s performance cost, θ, which is a random variable whose value is realized after the contract is signed but before delivery is due. Let $F(\theta)$ be the *cdf* of θ over $[0, \bar{\theta}]$, where $\bar{\theta}$ is a sufficiently large number that is known by both parties ($F' \equiv f > 0$). Upon the realization of θ, **Po** decides whether to perform or breach. If **Po** performs, the predetermined price of the good, i, is paid; if **Po** breaches, courts award damages, $D \geq 0$, to **Pe**. The players' payoffs when the contract is either performed or breached are summarized in Figure 1.

Given D and the contract being signed, the implementation stage is a two-person game under complete information; the game can be either simultaneous- or sequential-move. If each player makes a decision without knowing the other player's choice, the situation ought to be modeled as a simultaneous-move game. Meanwhile, if **Po**, prior to his decision, can observe **Pe**'s reliance, a sequential-move game should be more appropriate. Both are quite plausible in real contract situations. Since the effect of a certain damage measure critically differs under alternative game structures, we have to compare the simultaneous and the sequential natures of the contract game regarding the efficiency of a specific damage measure, that is, regarding the reliance level, breaching frequency, and total surplus. Let s_n be the strategy of player n, $n = 1, 2$.

Figure 1. Net Payoffs of the Promisor and the Promissee

	Perform	Breach
Promisor (Po)	$i - \theta$	$-D$
Promisee (Pe)	$V(r) - i - r$	$D - r$

2. The Social Optimum

We define *socially optimal strategy,* or simply *efficient strategy* as the one which maximizes the total expected surplus from the contract. Let s_n^* be the efficient strategy of player n. For efficiency, the promisor (**Po**) should perform iff $V(r) - \theta - r \geq -r$ (i.e., iff $\theta \leq V(r)$), and the promisee (**Pe**) should choose the efficient reliance, r^*, which maximizes the total expected surplus of the contract.

$$Max \int_0^{V(r)} [V(r) - \theta] f(\theta) d\theta - r \ = \ F(V(r))V(r) - \int_0^{V(r)} \theta f(\theta) d\theta - r. \qquad (1)$$

We can find easily the efficient reliance level r^* from the first order condition of equation (1), viz., $F(V(r))V'(r) - 1 = 0$. If the contract game is simultaneous, **Po**'s efficient strategy is perform iff $\theta \leq V(r^*)$.

Lemma 1. *The social optimum in a simultaneous-move game is (s_1^*, s_2^*) = (r^*, 'perform iff $\theta \leq V(r^*)$ '), where r^* satisfies $F(V(r))V'(r) - 1 = 0$.*

Meanwhile, if the game is of the sequential-move type, social optimality requires *sequential efficiency*.

(Definition) Sequential Efficiency: *In a sequential-move game, the efficient strategy should maximize the total expected surplus on every information set, even on those information sets that players do not believe ex ante themselves to reach.*

Lemma 2. *The social optimum in a sequential-move game is (s_1^*, s_2^*) = (r^*, 'perform iff $\theta \leq V(r)$, given r ').*

When the social optimum is achieved, what we actually observe, that is, the 'outcome' of the social optimum, is the players' ultimate choices along the equilibrium path. Therefore, the realized outcome under the social optimum will be '**Pe** chooses r^*, and **Po** performs iff $\theta \leq V(r^*)$.' Note that the outcome here is the same for both simultaneous and sequential contract games.

III. Efficiency of Expectation Damages

Expectation damages (ED) can be written as $D^{ed} = V(r) - i$. **Pe** is guaranteed the payoff that could be obtained in case that the contract is performed – regardless of whether or not it actually is performed. Therefore, **Pe**'s strategy is pre-determined independent of **Po**'s strategy, and so **Pe**'s optimal strategy would be identical in both simultaneous and sequential games. In other words, under ED, the *strategic interaction* is only *one-sided*, from **Pe** to **Po**, and not bilateral as in most game situations.[10]

Consider a simultaneous game first. Since **Po** does not observe r of **Pe**, he should have a belief r^E about r and make a decision on breach. **Po** will perform iff $i - \theta \geq -V(r^E) + i$, that is, iff $\theta \leq V(r^E)$. Meanwhile, **Pe**, not knowing the probability of **Po**'s performance either, will form a belief F^E on the performance probability and, choose r^{ed}, which maximizes $F^E[V(r) - i] + (1 - F^E)D^{ed} - r = V(r) - i - r$. We can obtain r^{ed} from the first order condition, $V'(r) = 1$. In equilibrium, beliefs are fulfilled, i.e., $r^E = r^{ed}$ and $F^E = F(V(r^{ed}))$.

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[10] That is, under ED, the reaction of the late mover (**Po**) does not affect the behavior of the first mover (**Pe**) even in sequential move games. It is shown later that the one-sided interaction runs in the opposite direction from **Po** to **Pe** under constant damages. Furthermore, as Bebchuk and Png (1999) keenly recognized, if the strategic interaction is one-sided, the equilibrium outcomes of the simultaneous and sequential games always are identical although the strategies themselves might be different.

On the contrary, consider a sequential-move game. **Po**, after observing **Pe**'s r, will perform iff $i - \theta \geq -V(r) + i$, that is, iff $\theta \leq V(r)$. Meanwhile, **Pe**, who can predict **Po**'s reaction, chooses r^{ed} which maximizes $F(V(r))[V(r) - i]$ $+ [1 - F(V(r))]D^{ed} - r = V(r) - i - r$. Since **Pe**'s objective function is the same as in the simultaneous game, the equilibrium r^{ed} will be the same as well. Based on the observations so far, we obtain the equilibrium under ED as follows.

Proposition 1. *The Nash equilibrium under expectation damages is* $(s_1^{ed}, s_2^{ed}) = (r^{ed}, \text{'perform iff } \theta \leq V(r^{ed}) \text{ '})$ *in the case of simultaneous-move games, and the subgame perfect equilibrium is* $(s_1^{ed}, s_2^{ed}) = (r^{ed}, \text{'perform iff } \theta \leq V(r),$ *given* r *') in the case of sequential-move games, where* r^{ed} *satisfies* $V'(r) = 1$.

Observation 1. $r^{ed} > r^{*}$.

The familiar property of over-reliance under ED is confirmed here by Observation 1. However, clarifications are to be made concerning the popular claim that "ED induces efficient breach." First, if the contract is of the simultaneous-game type, there will be too much performance since $F(V(r^{ed})) > F(V(r^{*}))$. Accordingly, ED guarantees neither efficient breach nor efficient reliance, contrary to the casual claim regarding the efficient-breach characteristic of ED.

Second, if the contract is of the sequential-game type, **Po**'s strategy is *sequentially efficient*, that is, ED induces efficient breach 'given r.' Nonetheless, too much performance will be realized *ex post* just as in simultaneous games, again because $F(V(r^{ed})) > F(V(r^{*}))$. Note that this over-performance stems not from the inefficiency of **Po**'s strategy but from the fact that **Pe** exploits ED and

chooses over-reliance.[11] The over-reliance necessarily induces over-performance by **Po**, who behaves efficiently 'given r.' Note that it thus would be false to conclude that ED produces efficient breach simply because **Po**'s reaction, '*perform iff $\theta \leq V(r)$*,' is identical to the condition for the social optimum: ED always results in over-performance.[12] The efficiency of a specific damage measure should be evaluated in terms of the equilibrium outcome, not in terms of equilibrium strategies.

Proposition 2. *If the contract is a simultaneous-move game, expected damages (ED) induce over-reliance and over-performance. If it is a sequential-move game, ED induces over-reliance and efficient breach given r. That is, ED induces the sequentially efficient strategy from the promisor. However, even in a sequential-move contract, ED always generates over-performance (along with over-reliance) as the equilibrium outcome.*

To summarize, in both simultaneous and sequential contracts, the equilibrium outcomes obtained under ED are over-performance and over-reliance. Therefore, we should be careful in interpreting the well-known proposition in the existing literature that ED induces efficient breach. The major tenet is that in the presence

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[11] A similar result is proposed by Kim (1997) who proves the inefficiency of the government's entry regulation. Although the entry regulation is sequentially efficient given the incumbent's move, it is exploited by the incumbent who intentionally evokes excess entry. Contrary to its original purpose, thus, the regulation protects the incumbent's monopoly position and lowers social welfare. Government's entry regulation is (sequentially) efficient only in subgames, but it is inefficient in the whole game.

[12] The sequential efficiency of breach under ED but its *ex post* over-performance are shown in their Proposition 2 and the related Remarks, respectively, in Bebchuk and Png (1999, p. 324). Nonetheless, the authors were not explicit about the inefficiency of equilibrium breach *per se* in simultaneous ED games, although they probably implied this in saying that "it is irrelevant whether the seller observe the actual reliance before choosing precautions."

of the one-sided strategic interaction, the equilibrium outcomes of the two different games are identical although the strategies themselves might be distinct.

One last comment is worth considering: "Whose fault is over-performing under ED (in a sequential game)?" We emphasize that it is not promisor's fault. Rather, it is a drawback of ED itself as an institution. The promisor's over-performace is an optimal reaction (or the best remedy) to the over-reliance of the promise at an earlier stage. Therefore, while it may be correct to say that ED is good in the sense that it induces optimal behavior from the promisor, it is undesirable because it generates over-performance as a result.[13]

IV. Efficiency of Constant Damages

1. Constant Damages

For the purpose of easy comparison with other measures and the social optimum, let constant damages (CD) be defined as $D^{cd} = V(\bar{r}) - i$, where $\bar{r}$ is a fixed level of reliance that is chosen in order to compare CD more readily with other damages. Since CD is invariant to the reliance level, **Po**'s behavior is predetermined, and **Pe**, knowing **Po**'s behavior, chooses his best reliance level. Hence, under CD, there exists, as under ED, a *one-sided strategic interaction* from **Po** to **Pe** but not the other way around. Specifically, **Po** performs iff $i - \theta \geq -D^{cd}$, that is, iff $\theta \leq V(\bar{r})$. Meanwhile, knowing this *a priori*, **Pe** chooses r^{cd} that maximizes $F(V(\bar{r}))[V(r) - i] + [1 - F(V(\bar{r}))][V(\bar{r}) - i] - r$. We can find r^{cd} from the first order condition, $F(V(\bar{r}))V'(r) = 1$.

Proposition 3. *The equilibrium under constant damages is* $(s_1{}^{cd}, s_2{}^{cd}) = (r^{cd},$

'perform iff $\theta \le V(\bar{r})$'), where r^{cd} satisfies $F(V(\bar{r}))V'(r) = 1$. They are identical in both simultaneous (Nash equilibrium) and sequential games (subgame perfect equilibrium).

Observation 2. $r^{cd} < r^{ed}$.

The efficiency feature of CD can be assessed easily from Proposition 3. First, the reliance level is efficient only when $\bar{r} = r^*$ in both simultaneous and sequential games; if $\bar{r} < r^*$, under-reliance is induced, and if $\bar{r} > r^*$, over-reliance is induced. Second, the breach decision is efficient in simultaneous-move games only when $\bar{r} = r^*$: if $\bar{r} < r^*$, over-breach is induced, and if $\bar{r} > r^*$, over-performance is induced. Meanwhile, in sequential-move games, the breach decision is sequentially efficient only when $r = \bar{r}$: sequential over-breach is induced if $r > \bar{r}$, and sequential over-performance is induced if $r < \bar{r}$. To put it differently, as **Po**'s strategy is fixed independent of r, it cannot be sequentially efficient except when $r = \bar{r}$.

Finally, the breach decision observed *ex post* in both simultaneous and sequential games is by no means efficient under CD, again simply because the amount of damages is fixed independent of r. If CD is small ($\bar{r} < r^*$), **Po** breaches too much, and knowing this, **Pe** chooses under-reliance. If CD is too large ($\bar{r} > r^*$), **Po** over-performs, and **Pe** therefore over-relies. Only when $\bar{r} = r^*$, which is the amount equal to the level of socially efficient reliance, **Po** breaches efficiently, and therefore, **Pe** relies efficiently. Indeed, in both simultaneous and sequential games, we do not confirm the existing claim regarding the efficient-reliance characteristic of CD except when $\bar{r} = r^*$. Policy makers again should be careful not to be misled by the casual submission in the literature that CD

warrants efficient reliance.[14] Proposition 4 summarizes the efficiency nature of CD in differing game structures.

Proposition 4. *If the contract is a simultaneous-move game, constant damages (CD) induce inefficient reliance and performance except when $\bar{r} = r^*$; if it is a sequential-move game, CD induces not only inefficient reliance except when $\bar{r} = r^*$ but also sequentially inefficient breach (except when $r = \bar{r}$). In sequential (and simultaneous) games, the efficient outcomes are not guaranteed ex post: 'Under-reliance ($r^{cd} < r^*$) with over-breach' or 'over-reliance ($r^{cd} > r^*$) with over-performance' is produced if $\bar{r} < r^*$ and $\bar{r} > r^*$, respectively.*

2. Perfect Expectation Damages: A Special Case of CD

As a special case of CD, perfect expectations damages (**PED**, hereafter) following, for example, Cooter and Ulen (2008, p. 216), have been known for long as the most desirable measure that induces both efficient reliance and breach.[15] PED is defined as $D^{ped} = V(r^*) - i$ in our model. **Po** performs iff $i - \theta \geq -D^{ped}$, that is, iff $\theta \leq V(r^*)$, which is the same condition as the social optimum. Meanwhile, **Pe** chooses r^{ped}, which maximizes $F(V(r^*))[V(r) - i] + [1 - F(V(r^*))][V(r^*) - i] - r$. From the first order condition, $F(V(r^*))V'(r) = 1$, it is confirmed that the reliance

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[14] The false argument that CD warrants efficient reliance seems to have emerged from the following misunderstanding: **Pe**'s reaction curve under CD is $F(V(\bar{r}))V'(r) - 1 = 0$ and that under the social optimum is $F(V(r))V'(r) - 1 = 0$. These two conditions look similar, but they are clearly different.

[15] Ever since Cooter (1985), PED has been discussed with differing names occasionally. (Professor Cooter did not use the term then either.) For example, Craswell (1989, p. 377) termed PED as an 'incentive optimizing damage scheme.' Leitzel (1989, p. 98) and Chung (1992, p. 291), citing Cooter (1985), also introduced the same kind of damage schemes. Spier and Whinston (1995, p. 182) called PED the 'efficient expectation damages,' and Bebchuk and Png (1999, p. 328) referred to it as a 'hypothetical expectation measure.' Their shared conclusion was that PED elicits efficient breach and reliance.

level under PED also is efficient, that is, $r^{ped} = r^*$.

Observation 3. *The equilibrium under perfect expectation damages (PED) is* (s_1^{ped} , s_2^{ped}) = ($r^{ped} = r^*$, *'perform iff* $\theta \leq V(r^*)$ *'), which is the same in both simultaneous and sequential-move games.*

Proposition 5. *In simultaneous-move games, PED elicits both efficient reliance and efficient breach. However, in sequential-move games, although efficient reliance is achieved, the promisor's breach decision is not sequentially efficient except when* $r = r^*$. *Nonetheless, the efficient outcomes are guaranteed ex post in sequential games.*

A notable result in Proposition 5 is that PED is 'sequentially inefficient,' which, to the authors' knowledge, is formally recognized for the first time in this paper. This is because PED is fixed independent of r , so that **Po** cannot adjust efficiently to many r-values that are different from r^*. The practical implication of the sequential inefficiency of PED can be explicated as follows. What if **Pe** chooses r that is not equal to r^*, due to the 'trembling hand.'[16] Whenever **Pe** chooses a value of r deviating from r^*, **Po**, if bound by PED, will have to perform inefficiently. For instance, over-breach (resp., over-performance) will be induced if $r > r^*$ (resp., $r < r^*$), respectively. PED's sequential inefficiency implies that it is not robust against even a small deviation by **Pe**.[17] However, it also is worth noting that efficient reliance and breach will be realized *ex post* in

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[16] We are grateful to an anonymous referee for making a clearer statement.

[17] This submission might be reinforced by the practical difficulty in implementing PED (e.g., finding r^*) as warned by Bebchuk and Png (1999, p. 328), although the authors did not recognize its sequential inefficiency. In fact, PED can have another defect as a 'perfect' damage measure; the participation constraint of the promisor may not be satisfied as it is shown in Kim et al. (2013).

equilibrium under PED.[18]

V. Efficiency of Reliance Damages

The use of reliance damages (RD) implies that the promisor (**Po**) should pay r in case of breach. Since the amount of damages is dependent on the promise (**Pe**)'s choice of reliance, *two-sided (or bilateral) strategic interaction* occurs between the two players, contrary to the *one-sided effect* under ED and CD.

1. Simultaneous-Move Games

Define RD as $D^{rd} = r$. As **Po** cannot observe r due to the nature of simultaneity, he should have a belief r^E about **Pe**'s reliance when making a decision on breach. With such a belief, **Po** will perform iff $i - \theta \geq -r^E$ (i.e., $\theta \leq i + r^E$). Meanwhile, **Pe** also chooses r^{rd}, which maximizes $F^E(V(r) - i - r)$ given the belief F^E about **Po**'s chance to perform. It is easy to see that r^{rd} is the same as r^{ed}, since the first order condition, $V'(r) = 1$, is the same.[19] Beliefs are fulfilled at equilibrium such as $r^E = r^{rd}$ and $F^E = F(i + r^{rd})$.

The underlying intuition for $r^{rd} = r^{ed}$ is as follows: Under ED, **Pe**'s payoff is $V(r) - i - r$ regardless of performance or breach. Meanwhile, under RD, **Pe** obtains the same $V(r) - i - r$ as under ED when the contract is performed with some constant probability, while his payoff is zero when the contract is breached. Therefore, **Pe**'s payoff under RD is a 'scale-down only of that under ED,' so that the maximum payoff would occur at the same reliance level.

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[18] This exactly is the opposite to the case of ED. The equilibrium strategy was sequentially efficient, but the realized outcome was over-performance always.

[19] To our knowledge, this relationship, $r^{rd} = r^{ed}$, was recognized by Cooter (1985), Emons (1991), and Bebchuk and Png (1999).

Proposition 6. *The Nash equilibrium under reliance damages in simultaneous-move games is (s_1^{rd} , s_2^{rd})=(r^{rd} , 'perform iff $\theta \leq i + r^{rd}$ '), where $r^{rd} = r^{ed}$.*

The $r^{rd} = r^{ed}$ result is contradictory to the usual proposition of $r^{rd} > r^{ed} > r^{*}$ in the literature, which holds only for the sequential-move game.[20] As we emphasized, the fundamental cause for the difference lies in the different game settings. More importantly, unlike the conventional claim that RD induces over-breach, Proposition 7 shows that RD even can induce over-performance. It fully identifies, for the first time, the equilibrium characteristics of the promisor's decision in 'simultaneous games.'

Proposition 7. *In simultaneous-move games, reliance damages induce over-reliance as much as expectation damages. There is over-breach, efficient breach, or over-performance if $i + r^{rd} < V(r^{*})$, $i + r^{rd} = V(r^{*})$, and $i + r^{rd} > V(r^{*})$, respectively.*

2. Sequential-Move Games

Now assume that **Po** makes a decision 'after' observing r chosen by **Pe**. **Po** will perform iff $i - \theta \geq -r$ (i.e., $\theta \leq i + r$). **Pe**, anticipating **Po**'s reaction, will choose r^{rd} which maximizes $F(i+r)(V(r) - i - r)$.

Proposition 8. *The subgame perfect equilibrium under reliance damages in sequential-move games is (s_1^{rd} , s_2^{rd}) = (r^{rd} , 'perform iff $\theta \leq i + r$ '), where $r^{rd} = \arg\max F(i+r)[V(r) - i - r]$.*

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[20] The latter relationship was proposed in the literature such as Shavell (1980), Rogerson (1984), and Bebchuk and Png (1999). The reliance level is greater than under ED because of '**Pe**'s ability to induce **Po** to vary the probability of performance' as correctly pointed by Bebchuk and Png (1999, p. 325-326).

Observation 4. $r^{rd} > r^{ed} > r^{*}$ *(Proof omitted).*[21]

Proposition 9. *In sequential-move games, reliance damages (RD) induce over-reliance since $r^{rd} > r^{ed} > r^{*}$ (heavier over-reliance than under expectation damages). Breach is not sequentially efficient, that is, RD induces more breach than the social optimum for all r, since $i + r < V(r)$ for all r. However, in equilibrium, breach can be realized ex post, as in a simultaneous-move game, at an exceedingly high, efficient, or exceedingly low level, depending on the relative magnitudes of $i + r^{rd}$ and $V(r^{*})$.*[22]

Note from Proposition 8 that the equilibrium is different under an alternative game structure, unlike the cases of ED and CD. It especially is worthwhile to note in Proposition 9 that RD even can result in over-performance on **Po**'s part, as an equilibrium outcome, in case $i + r^{rd} > V(r^{*})$. For instance, the greater the contract price is, the promisor is more likely to over-perform *ceteris paribus*, in order to avoid the relatively high level of r^{rd}. As mentioned in the Introduction, over-breach under RD has been the prevailing claim mostly in a sequential-game setting, a good example of which is Bebchuk and Png (1999, p. 325). However, the authors, in further comparing the breach levels under different game sequences in their Proposition 6, reached a couple of inaccurate conclusions.

First, they argued that there always is over-breach in both sequential and simultaneous games.[23] Yet, as they are discussing only sequential inefficiency

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[21] Note that the value of r^{rd} is different in simultaneous and in sequential games.

[22] Appendix depicts a graphical example in which when over-performance is likely to happen.

[23] "[N]ote that in **both** cases, the precaution level is lower than the **optimal level**, given the buyer's reliance decision: $X^{r} < X^{*}(R^{r})$." (p. 327, emphases added,) The last

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given reliance, their conclusion will be irrelevant for the simultaneous-game setting. Second, just based on the greater magnitude of precaution in the sequential game, they concluded (p. 327, emphasis added) that "the precaution level is **more efficient**" in that case. However, their criterion for *efficiency* is ambiguous. If they had ever had in mind considering 'equilibrium outcome' for both types of games, they should have compared, in their notations, the different levels of X^r (viz., $i + r^{rd}$ in our model) with $X^*(R^*)$ (viz., $V(r^*)$ in our model) instead. According to our Proposition 9, socially efficient or even excessive (i.e., more inefficient) performance can be realized *ex post* under RD.[24]

VI. Non-Standard Value Functions

In this short supplementary section,[25] we reevaluate ED and RD under non-standard value functions, that is, in the case that $V(r)$ is not concave from the origin as normally assumed. We select two cases here which, we believe, would have practical implications. Similar investigations were conducted for other functional forms, but we have decided to omit them such as a convex function as they appear to have no meaningful relevance.

1. Linear Value Function: $V = kr$ **,** $k > 0$

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inequality indicates that they are assessing only the efficiency of RD in sequential games, not its efficiency in simultaneous games.

[24] The last part of Proposition 9, thus, is believed to be one way to demonstrate formally to what Katz (1988, p. 559) submitted: "To the extent that reliance diverges from expectation, reliance damages can induce either excessive breach or excessive performance." Although an example of over-performance is offered in Posner (2007, p. 121), it is of a different sort because the current illustration in the text does not involve a so-called losing contract.

[25] We are deeply indebted to an anonymous referee for suggesting us to examine some non-standard functions to see if our earlier propositions still hold with robustness.

The value function can be linear. Assume, for example, that the promisee pre-purchases r units of some (possibly perishable) goods to resell them at net price k, expecting the promisor to finish construction on time for opening a shop. In such cases, r is the reliance level and the value from the contract is linear with r.

Consider the social optimum first. The first differential of the social welfare function is $SW' = F(V(r))V'(r) - 1 = F(kr)k - 1$. Note that $0 \le F(kr) \le 1$ and $F(kr)$ is increasing in r. Therefore, if $k > 1$, then $r^* = \infty$, while $r^* = 0$ if $k \le 1$.

Now let us analyze ED. Under ED, the first differential of **Pe**'s objective function is $V'(r) - 1 = k - 1$. The reliance level under ED is thus $r^{ed} = \infty$ if $k > 1$ and $r^* = 0$ if $k \le 1$. This result is sufficiently intuitive: the fact that $k > 1$ implies increasing returns from the reliance investment so that **Pe** will choose $r^* = \infty$. On the other hand, the fact $k \le 1$ means (constant or) decreasing returns so that $r^* = 0$ is the solution. Note that the reliance level under ED is exactly the same as the social optimum, which is a corner solution.

Next, consider RD. We know that if the underlying game is simultaneous move, then the equilibrium under RD is the same as that under ED, that is, $r^{ed} = r^{rd}$. Now consider a sequential move game. The first differential of **Pe**'s objective function is $F(i + r)(k - 1) + F'(i + r)(kr - i - r)$. It is easy to confirm that the result is the same as that of the simultaneous game; that is, if $k > 1, r^{rd} = \infty$, and if $k \le 1$, $r^{rd} = 0$. Proposition 10 summarizes the findings under a linear value function.[26]

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[26] We have thus far used two assumptions for illustrative convenience. First, the upper limit of θ, $\bar{\theta}$, is infinite. The second assumption is that k is slightly greater than 1 in

PROPOSITION 10 *If the value function is linear from the origin, then* $r^{ed} = r^{rd} = r^*$, *which is infinite if* $k > 1$ *and zero if* $k \leq 1$.

2. Minimum Fixed Cost Required in Reliance: $V(r) = 0$ for $r < r_0$ and $V(r) = v(r)$ for $r \geq r_0 > 0$, where $v' > 0$, $v'' < 0$, and $v(r_0) = 0$

This is the case where there exists a prerequisite of some fixed cost in reliance. (For illustrative convenience, assume that $i = 0$.) Suppose that a man has made a contract to buy a sport car. The value from the delivered sport car would be almost nil at least without obtaining a driver's license. Similar cases abound. It is well known that, ignoring the minimum fixed cost, $r^* < r^{ed} < r^{rd}$. Therefore, we only need to check whether the fixed cost is binding or not, that is, whether $V(r) > 0$ for r^*, r^{ed}, and r^{rd}, respectively.

Case (1) in Figure 2 is when the fixed cost is substantially high. In such case, it is easy to confirm that $r^{ed} = r^{rd} = r^* = 0$. Case (2) is referring to the situation when the fixed cost is sufficiently small so that it is not binding at all. Thus, it follows that $r_0 < r^* < r^{ed} < r^{rd}$. Finally, Case (3) is relevant for the situation when the level of the fixed cost is intermediate. Hence, it is binding for the social optimum, while it is not for ED and RD. In such case, $r^* = 0 < r_0 < r^{ed} < r^{rd}$. Note that $V(r) - r < 0$ at the standard r^* without the fixed cost (which is indicated as the second r^* in the parenthesis), so that the social optimum r^* should be zero with it as $V(r^*)$ is located under the 45-degree line. Thus, we offer Proposition 11.

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the case of $k > 1$ so that $F(kr)$ should be sufficiently high for the social optimum. (Otherwise, there will be r^* that uniquely satisfies $F(kr^*)k - 1 = 0$, causing ED and RD to result in overreliance when $k > 1$ in Proposition 10.)

Figure 2. The Case Where a Fixed Cost of Reliance Is Required

Case (1)

Case (2)

Case (3)
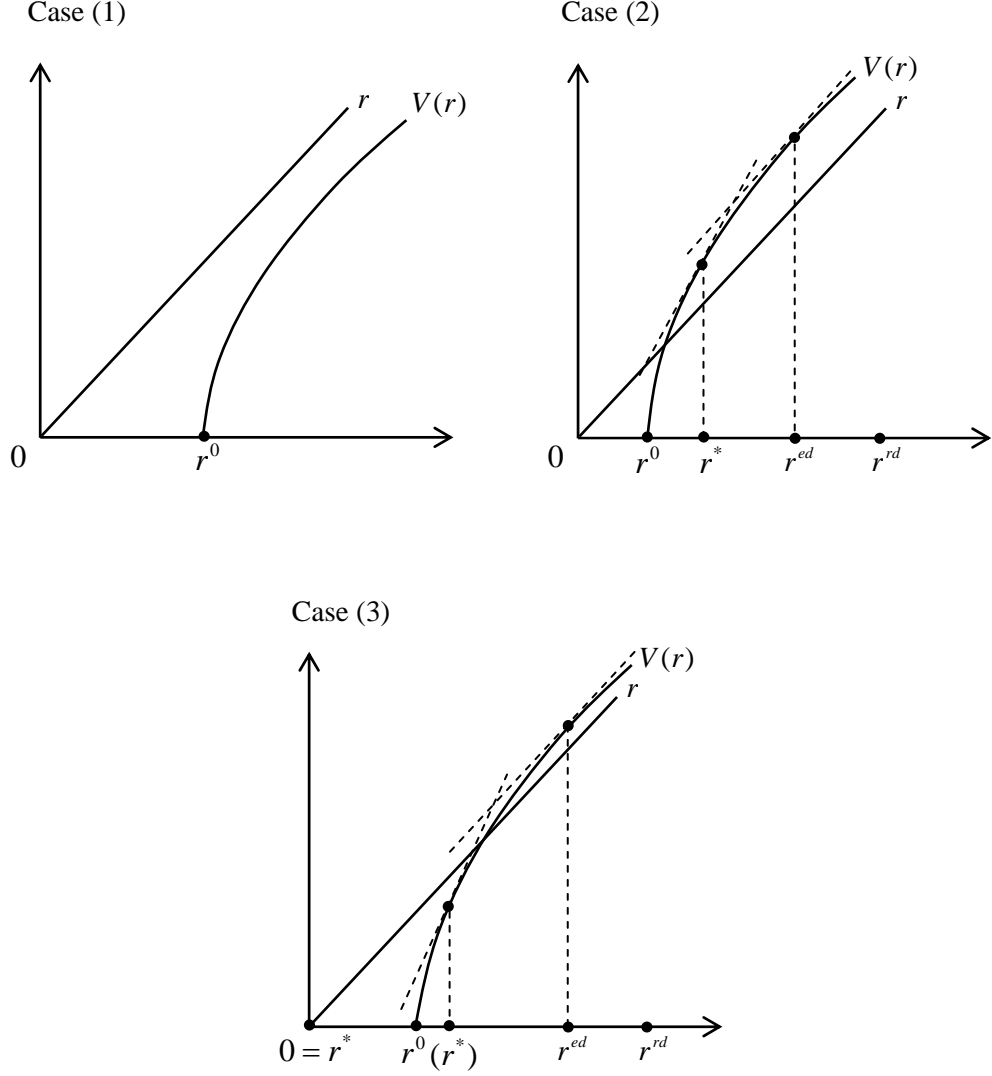
Proposition 11. *Assume that the minimum level of fixed cost in reliance is required. If the fixed cost, r_0, is substantially high, $r^{ed} = r^{rd} = r^* = 0$; if it is substantially small, $0 < r_0 < r^* < r^{ed} < r^{rd}$; if it has an intermediate value, $r^* = 0 < r_0 < r^{ed} < r^{rd}$.*

VII. Conclusions

Legal scholars and economists have been studying long about the economic characteristics, i.e., whether there is efficient reliance and breach, of various damage measures. They have accumulated several well-known propositions related to this vexing question. Some of these propositions, however, are likely to be potentially misleading primarily because the sequence of moves and the informational structure of the contract games are not clearly identified. This paper has attempted to clarify the fundamental sources of such misunderstanding and confusion.

We first focused on the general tendency of the existing literature not to distinguish strictly between *sequential* and *simultaneous contracts*. We subsequently emphasized the importance of the clear-cut distinction between *equilibrium strategy* and *equilibrium outcome*. Then, the three most popular damage measures (i.e., ED, CD, and RD) were examined, and several analytic results fairly contrary to the prevailing (mis)understanding were confirmed. Although part of these results was recognized in the past, the illustrations in this paper are more systematic and clearer. The most significant among them are as follows. As 'equilibrium outcomes,' ED always results in over-performance, efficient reliance mostly is not warranted under CD, and RD can generate over-performance.

All in all, a more explicit account of differing game structures and information conditions will advance further the existing research in this area of substantive law. As a natural extension to reflect the reality better, it will be interesting to see if there are any striking changes in the 'equilibrium outcome' under both simultaneous and sequential settings when informational asymmetry is introduced

regarding the reliance level or the performance cost.[27] Randomizing the value of performance (i.e., $V(r)$ in the model) will be another extension to reflect reality even more accurately.[28] Our expectation is that this additional uncertainty factor can trigger meaningful changes in the equilibrium outcomes of the damage measures so far.

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[27] The former, in particular, will shed critical implication particularly for RD, since a major justification of its use instead of ED lies in the allegedly easy measurement of reliance according to the Restatement (Second) of Contracts (§349 Comment a.): "The injured party may choose to do this [i.e., recover as damages his expenditures in reliance only] if he cannot prove his profit with reasonable certainty." However, if RD is used, and also if the true reliance level is only private information of the promisee, he will have an incentive to over-report, so that the performance of RD would be severely distorted. Considering such an incentive problem under asymmetric information, the court should design a revised RD which should be substantially different from the standard RD under complete information.

[28] This additional uncertainty is expected to bear particular relevance for, among others, the 'losing contracts.' These are defined generally as contracts whose net performance values are negative due to too high costs or too low (gross) values that are realized unexpectedly. See, for instance, Fuller and Perdue (1936, pp. 75-80), Cohen (1994, pp. 1270-1274), and Posner (2007, p. 121). Intriguingly enough, this analytic extension again will be beneficial for RD according to the Restatement (Second) of Contracts (§349 Comment a.): "He may also choose to do this [i.e., recover as damages his expenditures in reliance only] in the case of a losing contract, one under which he would have had a loss rather than a profit." In cases such as *Peevyhouse v. Garland Coal and Mining Co.* [382 P.2d 109 (Okla. 1962)] and *Groves v. John Wunder Co.* [205 Minn. 163, 286 N.W. 235 (1936)]), only the value of the contract declined unexpectedly, without any commitment in terms of expenditure on the part of the promisee. Also, various types of expenditure on top of the declined value realized later made the contract in question a losing one in *L. Albert & Son v. Armstrong Rubber Co.* [178 F.2d 182 (2d Cir. 1949)].

Appendix

The figure below depicts, in relation to Proposition 9, a situation where over-performance occurs under RD. It is clear that, as mentioned in the text, this possibility is reinforced as i increases *ceteris paribus*.

Figure A.1. The Possibility of Over-Performance under RD
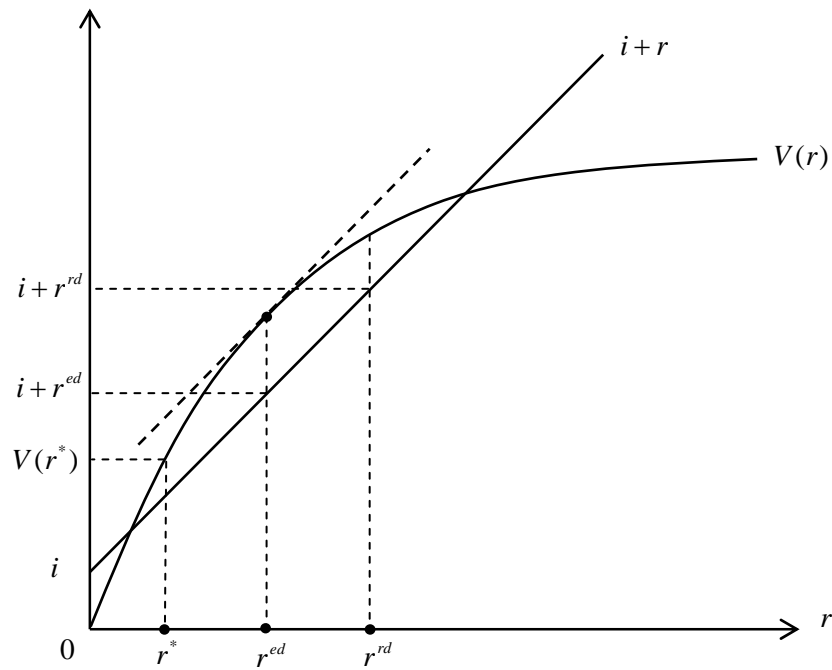
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