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# **Balancing Grower Protection Against Agency Concerns: An Economic Analysis of Contract Termination Damages**

**Myoungki Lee, Steven Y. Wu, and Maoyong Fan**

This study examines legislation that would grant growers termination damages if their contracts are terminated. Our model suggests that, with no contracting frictions, damages would not reduce ex ante efficiency as processors can contract around damages through contract restructuring. Growers would earn less under continuation but would be protected if terminated, although overall *expected* profits would be unaffected. However, when contracting frictions exist, then efficiency losses can occur as processors would be constrained in restructuring contractual incentives to deal with moral hazard. Growers' expected profits would increase while processors' profits would decrease.

*Key words:* contract law, contract regulation, damages, incentives, principal-agent

## **Introduction**

Many policy makers and farm advocates have alleged that contracts used in agricultural production or procurement are unfairly biased in favor of large food processors at the expense of growers. This debate has created political pressure in some states to enact new laws designed to regulate the contracting process. A model state law titled the Producer Protection Act (PPA) was recently proposed by 16 state attorneys general. The PPA provides a list of regulations designed to protect growers and to provide them with some bargaining power in the event they are involved in contract disputes with large food processors.<sup>1</sup> Among these regulations are rules that protect growers from undue termination or nonrenewal of contracts by providing growers with the right to be "... reimbursed for damages incurred due to the termination, cancellation, or failure to renew. Damages shall be based on the value of the remaining useful life of the structures, machinery or equipment involved" (PPA, Section 8).

One rationale for termination damages legislation is that, at the outset of a contract, processors often require farmers to make investments in new production facilities, which can be relationship specific whereby the facilities have little value outside the contract, making it difficult for growers to recapture their investments if they are terminated. For

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<sup>1</sup> The link <http://www.state.ia.us/government/ag/agcontractingexplanation.htm> provides a description of the Producer Protection Act in its entirety.

example, specialized broiler and hog housing facilities can have various dimensions of relationship specificity, and sugar beet production may require specialized harvesting equipment, investment in seed beds, etc. [see MacDonald et al. (2004) for an extensive discussion of asset specificity in agriculture]. These investments give contracts a long-term flavor in the sense that it may take several trading rounds (e.g., several seasons, flocks, etc.) before growers can pay off debts incurred from their investments.<sup>2</sup> However, many processors do not provide farmers with written guarantees that the contracts will not be terminated before all debts can be paid. For instance, a group of contract farmers in Arkansas were terminated by Tyson when Tyson ended its pork operation in the region (Smith, 2003).<sup>3</sup>

While many states have proposed or passed contract termination damages legislation, relatively few economic studies of these laws have been undertaken. The purpose of this article is to provide an economic analysis of contract termination damages. Specifically, we seek to develop an understanding of the efficiency and distributional consequences of damages. We emphasize that this study is simply an economic analysis of what would happen if damages legislation *were passed*. We do not make value judgments about the merits of the law, but instead point out potential consequences of the law using an economic framework.

This article makes a contribution to the small literature on agricultural contract regulation. A paper most closely related to ours is a study by Lewin-Solomons (2000), who also focuses on contract termination. The difference between the two papers is that she examines *restrictions* on termination whereas we evaluate *termination damages*. Our conclusions also differ. Lewin-Solomons finds that a reduction in the probability of termination is generally distortionary and creates unintended consequences which can actually harm growers. In contrast, our results suggest distortions only occur under contracting frictions which prevent processors from redesigning their contracts to “undo” the impact of damages. Our conclusion is consistent with the Coasian principle that enforcement and allocation of property rights would not be distortionary in the absence of transactions costs which create contracting frictions.

## Preliminaries

This section sets forth the fundamental assumptions of our economic model. We assume a processor is interested in manufacturing a downstream food product and the revenue from the sale of this product depends on the quality of an input commodity produced by the grower. While we assume the processor primarily cares about quality, in practice, a processor may care about a range of performance factors, including on-time deliveries, product consistency, ability to produce commodities with specific attributes, low levels

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<sup>2</sup> The investment costs can be substantial. For instance, Cunningham (2002) reports broiler production houses can exceed \$130,000 per house, and generally a minimum of two houses are required to make a production unit. Loans are usually amortized over 10 to 15 years and the physical life of a well-maintained house can be as much as 30 years. Annual fixed and cash costs can range from \$24,000 to \$28,000. Despite the long-term nature of these production facilities, broiler growers typically receive only short-term flock-to-flock contracts. In hog production it is common to observe 5- to 10-year contracts, but these contracts still may be shorter than the duration of the loan. Moreover, houses typically have a useful life of 20 years (Langemeier, 1993).

<sup>3</sup> The plaintiffs claim they had made expensive investments at the request of Tyson and sought damages for financial and emotional distress. Similar stories have been reported in other popular press articles and documented by various farm advocacy groups.

of pathogens to ensure food safety, etc. [see MacDonald et al. (2004) and Starbird (2005) for discussions of quality and food safety issues related to agricultural contracting]. Thus, one can easily replace the word “quality” with some other performance factor so long as that performance factor affects the processor’s revenue.

We assume quality can take two levels: “high” and “low.” When quality is high, the processor’s revenue is denoted by  $y > 0$ , whereas when it is low, revenue is 0.<sup>4</sup> The quality of the input commodity received by the processor is assumed to be stochastically related to “effort” exerted by the grower, where effort is unobservable so there is moral hazard. Hence, the processor uses contracts to overcome moral hazard and obtain high quality inputs.

We assume a principal-agent model between a risk-neutral contractor (e.g., principal/processor) and a risk-neutral grower (agent) who faces a limited liability (LL) constraint which limits the extent to which the processor can “punish” the grower for poor performance.<sup>5</sup> LL models are easier to solve than models with risk aversion, and at the same time do not trivialize the moral hazard problem.<sup>6</sup> Like the risk-aversion model of moral hazard, the LL model imposes a tradeoff—namely, the tradeoff between incentive provision and LL rents. The LL constraint can also be interpreted as a contracting friction created by wealth constraints or imperfections in the credit market.<sup>7</sup>

The sequence of events in the principal-agent game is consistent with stylized facts from agriculture. First, a processor offers a contract to a grower and acceptance is conditional on the grower making a large up-front investment to satisfy quality requirements of the contract. Hence, in order for the investment to pay off for the grower, the processor must offer the grower strictly positive future profits of a sufficient size to ensure the grower’s participation constraint is satisfied. If the processor terminates the grower prematurely, then the grower can suffer large losses, as she would be left with debt and no future profit stream from the contract.

We now describe the details of our model. Reservation profits for both the processor and grower are zero. Quality of the input commodity is verifiable and affected by the grower’s action. The grower can exert unobservable effort  $e \in \{0, 1\}$ , where the cost of high effort is given by  $ce$ , and where  $c > 0$ . If the grower exerts high effort ( $e = 1$ ), then the probability of high quality is given by  $p_H$ . When the agent shirks ( $e = 0$ ), then the probability of high quality is  $p_L = p_H - \Delta p$ , where  $\Delta p = p_H - p_L$  and  $p_H > \Delta p > 0$ . For simplicity, we assume the processor’s revenue is simply  $y$  multiplied by some constant,  $k \geq 0$ , i.e.,  $R(y) = ky$ .

The processor requires the grower to undertake a verifiable investment in the most up-to-date facilities, and/or latest technology. The monetary value of this investment is

<sup>4</sup> The assumption of zero revenues is for notational convenience. We could have defined revenue under low quality to be some nonzero number less than  $y$ . However, this would add little additional insight at the cost of substantially complicating the subsequent analysis.

<sup>5</sup> In jargon-free language, limited liability constraints essentially act as “payment floors” which prevent the processor from promising excessively low payments in some state of the world. This constrains processors from using “sticks” or punishments to motivate growers. Incentives must then be delivered mostly through bonuses rather than deducts.

<sup>6</sup> It is well known that without limited liability, a simple solution to the moral hazard problem is just to make the agent the residual claimant.

<sup>7</sup> For instance, growers might be wealth constrained, which makes negative payments (transfers from growers to the processors) infeasible. In some cases, even positive but low payments might be ruled out. Some lenders will not approve loans unless the contract guarantees the grower at least some minimal payment even under poor performance. This limits the extent to which processors can use deducts to provide incentives so that incentives must be delivered primarily through bonuses rather than deducts.

denoted by  $I$  and we treat this investment as a discrete fixed cost that must be made by the grower as part of the contractual agreement. We assume the parties are price takers in the market for the fixed asset so that the *level* of  $I$  is exogenous in the contracting problem—the only choice available to the parties is whether to make the investment or not, but they cannot influence the cost.  $I$  is also assumed to be completely relationship specific, whereby its salvage value is zero outside the relationship. This assumption is not essential; all that matters is that  $I$  loses some value outside the relationship, but assuming full asset specificity simplifies notation.<sup>8</sup>

If production and exchange take place, the processor makes contractually specified payments to the grower denoted by the vector  $\mathbf{w} = (w_l, w_h)$ , where  $w_x$  represents the payments to the grower contingent on whether quality is high ( $x = h$ ) or low ( $x = l$ ). For reasons discussed earlier, we assume limited liability (LL) restricts feasible contract payments to  $w_x \geq 0$ .

After the grower has invested  $I$  and before she chooses effort, we assume a verifiable exogenous shock is revealed. This shock allows us to introduce nonperformance-related contract termination where the grower may not receive all promised future payments. This occurs in agriculture and many other industries. Negative shocks can induce firms to close plants or exit an industry, resulting in a layoff of growers or workers.

We assume the probability of a good shock is  $v$ , which yields  $k = 1$  so that processor revenue will be  $R(y) = ky = y$ . The probability of a bad shock is given by  $1 - v$ , which yields  $k = 0$  with revenue of  $R(y) = 0$ , regardless of grower performance. Thus, total surplus will be nonpositive under the bad shock. Given the large initial investment made by the grower, the processor must promise the grower positive future profits to ensure the grower's participation constraint is satisfied. This implies that, under a bad shock, the processor will always earn negative profits under continuation and would therefore terminate the grower.

Our assumption that growers may be terminated before they engage in production and exchange may seem unrealistic because, in practice, growers typically engage in *some* production before being terminated. Although our assumption is admittedly an abstraction of the real world, it nevertheless allows us to capture the essential feature that growers may not receive full future compensation promised by processors. A more realistic model may involve multi-period contracting where the grower is terminated before the final period of the contract, but such a model would substantially complicate the analysis while adding very little additional insight.<sup>9</sup>

The timing of the contracting game is as follows. In stage 1, the processor offers a contract to the grower. If the grower accepts, she must make the investment  $I$ . In stage 2, before production takes place, the exogenous shock is revealed. If a bad shock occurs, the processor terminates the contract and the grower's profit is a loss in the amount  $-I$ . If a good shock occurs, the game continues into stage 3. The grower exerts effort, which is followed by the realization of quality, which in turn triggers payments from the processor in the amount  $w_x$ . The relationship concludes at the end of stage 3.

<sup>8</sup> It is also possible to allow the processor to choose the *degree* of asset specificity so that the *level* of  $I$  becomes a choice variable in the contracting problem, but this assumption would be suspect. As Erkal (2007) points out, asset specificity is largely driven by the need for specialized inputs for downstream goods. Thus, asset specificity may be a function of the downstream product portfolio of firms rather than a direct choice variable.

<sup>9</sup> Indeed, earlier drafts of this paper featured a two-period contracting model. We thank an anonymous reviewer for pointing out that a one-period model would suffice and substantially simplify the analysis.

We assume  $v(p_H y - c) - I \geq \max\{v p_L y - I, 0\}$ . This assumption implies that, in a first-best world, contract acceptance and high effort should be implemented, *ex ante*.<sup>10</sup> In addition, if  $v p_L y - I \geq 0$  holds, then the above condition condenses to  $\Delta p y \geq c$ . These assumptions allow us to focus on the most interesting case where implementing high effort is consistent with social welfare maximization. Our final assumption is that when profits to the processor are identical under  $e = 1$  and  $e = 0$ , the processor prefers  $e = 1$ .<sup>11</sup> A key point to note, in the presence of moral hazard, is that the processor may not always choose the first-best effort profile of  $e = 1$ , as the processor's profit is social surplus minus LL rents paid to the grower to induce high effort. Consequently, for some parameter values, the processor may choose not to implement first best in order to keep rents small. This insight will be useful later. All mathematical notation and symbols are summarized in table 1.

### Optimal Contracting, Efficiency, and Distribution Without Termination Damages

In this section, we describe efficiency and distribution outcomes in the absence of termination damages. This provides a benchmark for assessing the impact of damages later. In the absence of damages, the processor will design a contract that specifies a payment profile,  $\mathbf{w} = (w_l, w_h)$ , which induces the agent to choose some effort level,  $e$ . Alternatively, one can think of the processor as indirectly "choosing" effort by providing the grower with an incentive-compatible contract.<sup>12</sup> Moreover, under our assumptions, the processor always terminates the contract under a bad shock and earns zero profits. Thus, the processor designs the optimal contract to maximize her expected profit. Specifically, she solves:

$$(1) \quad \max_{\mathbf{w}; e} v \left\{ [e p_h + (1 - e) p_l] [y - w_h] - [1 - e p_h - (1 - e) p_l] w_l \right\}$$

subject to the grower's incentive compatibility (IC) constraint, participation constraints, and LL constraints. To specify the IC constraint, note that the grower would only choose high effort ( $e = 1$ ) if her expected profits under high effort are greater than expected profits under low effort ( $e = 0$ ). Thus, a processor who wants to implement high effort will need to choose a payment profile whereby promised expected profits to the grower are greater (weakly) under  $e = 1$ . To see this, note that the grower's objective function is given by:

<sup>10</sup> However, *ex post* (after the exogenous shock is revealed), it may be more efficient to terminate the relationship under a bad shock as surplus from continuation would be nonpositive. Thus the condition  $v(p_H y - c) - I \geq \max\{v p_L y - I, 0\}$  that justifies *ex ante* high effort implicitly assumes there is efficient *ex post* breach which would yield a surplus of zero under a bad shock.

<sup>11</sup> This assumption is harmless but allows us to simplify our analysis in much the same way that, in the standard agency literature, agents are assumed to prefer acceptance of a contract over rejection of a contract when their reservation profit is satisfied with equality.

<sup>12</sup> It is standard in the contract theory literature to assume that effort is a choice variable for the principal even under moral hazard. The rationale is that the principal, when designing the contract, decides what level of effort she would like the agent to choose. Then she designs a contract or incentive system to induce the agent to choose that effort level. So while the agent ostensibly chooses effort, she is actually responding to the grand plan of the principal. A practical example is that in most companies, it is the CEO or senior management (the principals) who create and decide on the philosophical and cultural values (which influence the work ethic) of the firm. Then they design compensation and reward systems to encourage employee buy-in. Under the right reward/penalty structure, employees will work in accordance with the plan envisioned by senior management.

**Table 1. Descriptions of Mathematical Symbols**

Symbol	Description
$y$	Quality of the input commodity exchanged between the processor and seller.
$e$	Effort or short-term investment made by the grower, which is stochastically correlated with $y$ ; i.e., higher effort results in higher probability of high $y$ .
$c$	A constant representing the marginal cost of effort.
$p_H$	The probability of high quality ( $y$ ) given high effort ( $e = 1$ ).
$p_L$	The probability of high quality given low effort ( $e = 0$ ).
$\Delta p$	Difference in the above probabilities, i.e., $\Delta p = p_H - p_L$ .
$R(y)$	Revenue to the processor.
$k$	Revenue scalar; thus, total revenue to the processor is $R(y) = ky$ .
$I$	Monetary value of the relationship-specific fixed asset that must be made at the start of a contracting relationship.
$\mathbf{w} = (w_l, w_h)$	The vector $\mathbf{w}$ denotes contractually specified payments to the grower where $w_x$ represents the payments to the grower contingent on whether quality is high ( $x = h$ ) or low ( $x = l$ ).
$v$	The probability of a good shock, which yields $k = 1$ so that processor revenue will be $R(y) = ky = y$ ; the probability of a bad shock is given by $1 - v$ , which yields $k = 0$ .

$$(2) \quad v \left\{ [ep_h + (1-e)p_l]w_h + [1-ep_h - (1-e)p_l]w_l - ce \right\} - I.$$

The grower will therefore choose high effort over low effort if and only if:

$$(3) \quad v \left\{ p_h w_h + [1 - p_h] w_l - c \right\} - I \geq v \left\{ p_l w_h + [1 - p_l] w_l \right\} - I,$$

which can be simplified to:

$$(4) \quad w_h - w_l \geq \frac{c}{\Delta p}.$$

Condition (4) is the IC constraint for implementing  $e = 1$ . It is straightforward to show, for a profit-maximizing processor, that (4) will be satisfied with equality under the optimal contract. This would then imply:

$$(5) \quad w_h = w_l + \frac{c}{\Delta p},$$

where  $c/\Delta p$  represents a performance premium which is required to induce the grower to exert high effort. Note also that the LL constraints restrict all payments to  $w \geq 0$ , so the processor can only use performance premiums but cannot use deducts (negative payments) to punish low performance.

A participation constraint also must be satisfied to ensure the grower will accept the initial contract. This constraint simply requires that the grower's expected profit be greater than zero, i.e.:

$$(6) \quad v \left\{ [ep_h + (1-e)p_l]w_h + [1-ep_h - (1-e)p_l]w_l - ce \right\} - I \geq 0.$$

The grower's high-effort profit can be determined by substituting  $e = 1$  and (5) into (6) to obtain:

$$(7) \quad u(1) = v \left[ w_l + \frac{p_l c}{\Delta p} \right] - I.$$

Note that (7) must be nonnegative to ensure the participation constraint is satisfied. Whether it is strictly greater than zero (grower earns rents), or whether it holds with strict equality (grower earns no rents) depends on the level of  $I$ . The driving factor is that when  $I$  is large enough,  $w_l > 0$  might be necessary to ensure the grower's participation constraint is satisfied so the LL constraint might not bind. In this case, the grower would earn no rents because the processor would only set  $w_l$  to a level that just forces the participation constraint to bind with equality. In fact, whenever the grower can earn rents, the processor will attempt to extract this rent away by lowering  $w_l$  until (7) is exactly equal to zero. The complicating factor is that if the limited liability rent,  $p_l c / \Delta p$ , is large relative to  $I$ , then the processor may need a negative  $w_l$  to extract all grower rents. But the LL constraint may prevent the processor from offering a negative  $w_l$ . In this case, the grower will be left with some rents. The following remark summarizes the argument.

- **REMARK 1.** *Suppose the processor wants to implement  $e = 1$ . If  $v p_l c / \Delta p > I$ , then the grower earns rents.*

*Proof.* Proofs for all remarks and propositions are provided in the appendix.

Remark 1 identifies the threshold that  $I$  cannot exceed in order for the grower to earn rents. This threshold depends on exogenous parameters  $v$  (probability of good shock),  $c$  (cost of high effort),  $\Delta p$  (the gain in probability of high quality from choosing high effort), and  $p_l$  (probability of high quality given low effort). Also note that when  $v(p_l c / \Delta p) \leq I$ , then no rents will be earned by the grower since the processor can set  $w_l$  such that (7) equals zero, i.e.,  $w_l = I/v - p_l c / \Delta p$ . Thus, in general:

$$(8) \quad w_l = \max \left\{ 0, \frac{I}{v} - \frac{p_l c}{\Delta p} \right\}$$

and

$$(9) \quad w_h = \max \left\{ 0, \frac{I}{v} - \frac{p_l c}{\Delta p} \right\} + \frac{c}{\Delta p}.$$

It should also be noted that if the processor wants to implement  $e = 0$ , then the processor never has to pay rents as no performance premiums need to be provided. Hence, the grower would earn no rent when the processor wants to implement low effort.

Remark 1 paves the way for our first main result, which characterizes the expected profits earned by the processor and grower under optimal contracts that implement each of the relevant effort levels. These expected profit expressions will subsequently allow us to assess the distributional consequences of termination damages.

- **PROPOSITION 1.** *The expected profits to the processor and grower (denoted by  $\pi_e$  and  $u_e$ , respectively) from implementing effort levels  $e = 1$  and  $e = 0$  are:*



$$(10) \quad \pi_{e=1} = v[p_h y - c] - I - \max\left\{0, \frac{vp_l c}{\Delta p} - I\right\}$$

and

$$(11) \quad u_{e=1} = \max\left\{0, \frac{vp_l c}{\Delta p} - I\right\},$$

$$(12) \quad \pi_{e=0} = vp_l y - I,$$

$$(13) \quad u_{e=0} = 0.$$

Proposition 1 allows us to obtain exact representations of profits under each effort level desired by the processor. When  $I$  falls below the thresholds identified in Remark 1, then the grower earns positive rents in the amount  $vp_l c/\Delta p - I$  under  $e = 1$ . When  $I$  exceeds the threshold, then the grower earns zero rents.

We now ask what effort level the processor would want to implement. Note that the processor wants to maximize expected revenue while reducing LL rents. However, rents would only exist if  $I$  is reasonably low. When  $I \geq p_l c/\Delta p$ , the LL constraint would not bind, and the grower would earn no rents even if the processor implements  $e = 1$ . In this case, the processor need not worry about paying rents to the grower and can focus on maximizing her expected profit, which is now equivalent to social surplus, since the processor's expected profit is just total surplus minus rents. Proposition 2 formalizes the intuition.

- **PROPOSITION 2.** *Under the optimal contract, the processor would implement  $e = 1$  if and only if:*

$$\Delta p y \geq c + \max\left\{0, \frac{p_l c}{\Delta p} - \frac{I}{v}\right\} \text{ and } p_h y \geq c + \max\left\{\frac{p_l c}{\Delta p}, \frac{I}{v}\right\}.$$

The main point of Proposition 2 is that the optimal effort to the processor will depend on the revenue earned from high quality ( $y$ ), the probabilities of high quality ( $p_h, p_l$ , and  $\Delta p$ ), the cost of high effort ( $c$ ), the probability of a good shock ( $v$ ), and the level of investment ( $I$ ). What is of particular interest is the relationship between  $y$  and  $I$  holding all else constant, as it allows us to study the relationship between the benefits of quality and the fixed cost of producing that quality via the relationship-specific investment  $I$ .

Note, when  $y$  is high, it increases the likelihood the processor will prefer to implement high effort. However, when

$$\Delta p y < c + \max\left\{0, \frac{p_l c}{\Delta p} - \frac{I}{v}\right\},$$

then the return to high quality is low and the processor may maximize profits by saving on LL rents instead. This can be achieved by simply not offering the grower incentives to choose high effort.

The impact of a higher  $I$ , holding all else constant, is more ambiguous. If  $I$  is low enough such that the processor must pay rents, then a small increase in  $I$  which does not violate the condition  $p_l c/\Delta p > I$  will enhance the likelihood of high effort because it decreases the LL rents paid to the grower. However, when  $I$  is sufficiently high whereby  $p_l c/\Delta p > I$  is violated, then an increase in  $I$  will have no impact on the processor's effort preference, but will decrease the likelihood that the processor would contract in the first

place. Intuitively, for large  $I$ , the processor must offer a large payment,  $w_l$ , to induce the grower to make the investment, but this would only be worthwhile to the processor if revenue,  $y$ , is large.

A succinct summary of this section is that when a contracting friction caused by a binding LL constraint exists, then processors must pay rents to growers to implement high effort. This would decrease the likelihood of the implementation of high effort. Whether the LL constraint is binding or not depends on the size of the relationship-specific investment  $I$ . When  $I$  is large so that the grower must make a large relationship-specific investment, the processor must raise the grower's expected pay by raising  $w_l$  to ensure the grower earns at least her reservation profits. In this case,  $w_l$  would be well above the LL constraint of  $w_l = 0$ , so the LL constraint would not bind. Hence, the processor has the freedom to adjust  $w_l$  to meet the grower's participation constraint without having to pay any LL rents. Moreover, the processor's ability to provide incentives would not be compromised as the inequality given by (4), which is the incentive-compatibility condition, can be maintained without cost. In short, if the processor offers a contract, the contract will always induce the grower to exert high effort. Conversely, if  $I$  is sufficiently small relative to LL rents, then the processor would like to lower  $w_l$  to extract away the LL rents paid to the grower. However, once  $w_l = 0$  is reached, the LL constraint binds and no more rents can be extracted so that the grower will earn some rents. The only way for the processor to avoid paying rents is to forego contracting for high effort. Thus, even if the processor offers a contract, the processor may still contract only for low effort if the returns to high effort do not outweigh the LL rents. This reduces the likelihood of high effort conditional on a contract offer.

### Optimal Contracting, Efficiency, and Distribution in the Shadow of Termination Damages

In this section, we conduct a similar analysis as in the previous section, but we assume that a termination damages legislation is in place. A comparison of the results in this section to the results in the previous section will highlight the impact of termination damages on efficiency and distribution. Under the legislation, producers are entitled to receive damages, denoted by  $D$ , if the processor terminates the grower under a negative shock. The processor's objective function (1) changes to:

$$(14) \quad \max_{w,e} v \left\{ [ep_h + (1-e_l)p_l][y - w_h] - [1 - ep_h - (1-e)p_l]w_l \right\} \\ + (1-v) \max \left\{ -D, \pi_e^b \right\},$$

where  $\pi_e^b$  represents the processor's profit from contract continuation even under a bad shock. Under the assumptions outlined in the "preliminaries" section, we have:

$$(15) \quad \pi_e^b = -[ep_h + (1-e)p_l]w_h - [1 - ep_h - (1-e)p_l]w_l,$$

which is a loss for the processor. Under the shadow of termination damages, the processor must choose between paying damages,  $D$ , or not paying damages and continuing with the contract. Thus, in the shadow of damages, the processor solves (14) subject to the IC constraint, participation constraint, and LL constraints.

The participation constraint is affected by whether the processor chooses to breach and pay damages or to continue with the contract under a bad shock. To specify the participation constraint, first define the binary variable:

$$(16) \quad i = \begin{cases} 1 & \text{if } \max\{-D, \pi_e^b\} = -D, \\ 0 & \text{if } \max\{-D, \pi_e^b\} = \pi_e^b. \end{cases}$$

Then the grower's participation constraint is given by:

$$(17) \quad [v + (1-v)(1-i)] \{ [ep_h + (1-e)p_l]w_h + [1 - ep_h - (1-e)p_l]w_l - ce \} + (1-v)iD - I \geq 0.$$

Using (17), it is also straightforward to show that the IC constraint is unaffected by damages and remains identical to (5). This is because damages are based on *promised* profits and cannot be based on actual profits. Because promised profits and effort profiles are determined at the time the contract is offered and agreed upon, the agent cannot alter the level of damages by her choice of effort after the contract is signed.<sup>13</sup>

If the processor wants to implement  $e = 1$ , we must consider two cases. In case (a),  $D$  may be sufficiently low so that the processor will choose to terminate the contract and pay the grower  $D$  under a bad shock. In case (b), if  $D$  is set too high, then the processor will choose continuation even under a bad shock. To determine which case is more relevant, note that PPA Section 8 specifies: "Damages shall be based on the value of the remaining useful life of the structures, machinery, or equipment involved." One can interpret this to mean a level of damages approximating the legal principle of *reliance damages*, as it would essentially compensate the grower for her relationship-specific investment (i.e.,  $D = I$ ). For purposes of this paper, we can restrict our attention to case (a) because Wu (2007), using a similar model, has shown that under reliance damages, the processor will always choose to terminate and pay damages rather than elect to continue.

To determine grower's profit under case (a), we can substitute  $e = 1$ ,  $i = 1$ ,  $D = I$ , and (5) into (17) to obtain:

$$(18) \quad u_d(1) = v \left[ w_l + \frac{p_l c}{\Delta p} \right] - vI.$$

Note, in comparison to (7), the impact of damages is to scale down the investment costs  $I$  by the probability of a good shock  $v$ . Thus, all else equal, the expected profits for growers would increase under damages. To ensure the participation constraint is satisfied under damages, (18) must be nonnegative. The presence of termination damages changes the conditions outlined in Remark 1.

<sup>13</sup> It also well known in the law and economics literature that damages should be made independent of actions available to victims of breach. This would prevent the victim of breach from *over-relying* (over-investing or over-exerting effort) in order to influence the size of damages. In legal terms, courts tend to adhere to the doctrine of *foreseeability* where damages should be fixed at the level that would emerge when victims take reasonably "foreseeable" actions. Thus, if growers, in an effort to increase damages, exert excess effort or make excessive investments, they would not be rewarded because these actions would not be considered "foreseeable." See Perloff (1981) or Bebchuk and Shavell (1991) for economists' perspectives on the doctrine of foreseeability.

- **REMARK 2.** *Suppose the processor wants to implement  $e = 1$  in the shadow of damages. Then the grower earns rents if  $p_l c / \Delta p > I$ .*

Compared to Remark 1, it is clear that damages relax the rent threshold whereby, all else equal, the grower is likely to earn more rents. If the processor will breach and pay damages, then if  $p_l c / \Delta p \leq I$  [compared to  $v(p_l c / \Delta p) \leq I$  from Remark 1], the grower will earn no rents since the processor can set  $w_l = I - p_l c / \Delta p > 0$ , in which case (18) will equal zero. On the other hand, when  $p_l c / \Delta p > I$ , then only  $w_l = 0$  is possible given the LL constraint. In this case, the grower would earn rents. In general, with termination damages, the optimal contract yields payments:

$$(19) \quad w_l = \max \left\{ 0, I - \frac{p_l c}{\Delta p} \right\}$$

and

$$(20) \quad w_h = \max \left\{ 0, I - \frac{p_l c}{\Delta p} \right\} + \frac{c}{\Delta p}.$$

Comparing (19) and (20) to (8) and (9), note that when the LL constraint does not bind,  $w_l$  will be lower than in the nondamages scenario. This is because the grower will no longer lose her relationship-specific investment,  $I$ , in any state of the world and her expected profits will increase if the processor does not make any adjustments to payments. Of course, a rational processor *will* respond to damages legislation by lowering  $w_l$  while ensuring the grower's participation. However, when the LL constraint is binding, then the processor is constrained in lowering  $w_l$ , thereby leaving the grower with rents. Finally, it should be noted that the processor never needs to pay the grower rents for implementing  $e = 0$ , so the grower earns no rents.

We now state our third main result which characterizes the expected profits earned by the processor and grower in the presence of damages.

- **PROPOSITION 3.** *The expected payoffs to the processor and grower from implementing effort levels  $e = 1$  and  $e = 0$  in the shadow of damages are:*

$$(21) \quad \pi_{e=1D} = v[p_h y - c] - I - \max \left\{ 0, \frac{v p_l c}{\Delta p} - v I \right\},$$

$$(22) \quad u_{e=1D} = \max \left\{ 0, \frac{v p_l c}{\Delta p} - v I \right\},$$

$$(23) \quad \pi_{e=0D} = v p_l y - I,$$

$$(24) \quad u_{e=0D} = 0.$$

A simple comparison between Proposition 3 and Proposition 1 can also provide insight into how termination damages might affect expected profits of both parties. For the case where the processor wants to implement  $e = 1$  and terminates (and pays damages) under a bad shock, when the LL constraint is not binding, the processor can undo damages simply by proportionally lowering the contract payment,  $w_l$ , to extract away any LL rents needed to incentivize the grower. Thus, the expected profits from Proposition 1 and Proposition 3 converge so that damages would have no impact on profits of either

party and social efficiency is unchanged. Here, the grower is only promised zero economic profits while the processor would earn  $\pi_{e=1} = v[p_h y - c] - I$ . However, if the LL constraint is binding, then there are contracting frictions which prevent the processor from reducing incentive costs by lowering  $w_l$ . Hence, in order to implement  $e = 1$ , the processor would have to pay LL rents to the grower up to  $u_{e=1D} = (vp_l c / \Delta p) - vI$ , and the processor's expected profit would decrease by the same amount. To assess the magnitude of redistribution under damages, recall from Proposition 1 that the nondamages grower rents are  $u_{e=1} = (vp_l c / \Delta p) - I$ . Thus,  $u_{e=1D} - u_{e=1} = (1 - v)I$ , so that damages can potentially increase grower rents (and decrease processor rents) by  $(1 - v)I$ . Note,  $(1 - v)I$  is simply the expected investment loss from a bad shock, which is no longer borne by the grower under damages. Finally, when the processor wishes to implement  $e = 0$ , damages have no impact on the profits of either growers or processors.

We now examine the efficiency consequences of damages. By efficiency, we mean ex ante efficiency related to the processor's ability to implement  $e = 1$ , which is the socially efficient level of effort. Ex ante efficiency would be compromised if damages increase the likelihood of the processor contracting for lower effort. Recall that the fundamental issue facing the processor when deciding to implement  $e = 1$  is whether the returns to high effort are worth the increase in LL rents. Therefore, the impact of damages on effort will depend on how LL rents are affected by damages.

- **PROPOSITION 4.** *In the shadow of damages, the processor would implement  $e = 1$  if and only if:*

$$\Delta p y \geq c + \max \left\{ 0, \frac{p_l c}{\Delta p} - I \right\} \text{ and } p_h y \geq c + \max \left\{ \frac{p_l c}{\Delta p} + \frac{(1-v)}{v} I, \frac{I}{v} \right\}.$$

A comparison of Propositions 2 and 4 will provide some insight into how damages might affect the processor's propensity to contract for effort. Once damages are introduced, then Proposition 4 clearly suggests that the right-hand sides of the inequalities in Proposition 2 potentially increase by the amount  $[(1 - v)/v]I$ . Thus, if the LL constraint is binding, then LL rent increases, making it harder to satisfy the inequality constraints and thereby decreasing the likelihood of high effort being implemented. However, if the LL constraint is not binding so that there are no contracting frictions, damages would not affect the inequalities and ex ante efficiency would remain unchanged. Consequently, whether damages are distortionary or not depends on whether contracting frictions exist.

A practical interpretation of our results is that ex ante efficiency losses would most likely occur in industries where processor revenue is low enough so that introducing termination damages would cause the inequalities in Proposition 4 to be violated. For high-value industries where processors gain significantly from high quality (i.e.,  $y$  is large enough for the processor to cover all grower expenses, including large fixed costs), processors would implement high effort regardless of whether damages are in place or not. Thus, from an efficiency perspective, our model predicts that processors of high value-added goods would remain relatively unaffected by termination damages whereas processors of medium or low value-added goods would most likely be affected. In effect, we would predict that such a law would cause some intermediate quality downstream goods to disappear from the market.

## Conclusion

This article examines the potential impact of contract termination damages laws (e.g., Section 8 of the Producer Protection Act), which would grant growers termination damages if their contracts are terminated or not renewed by processors. These laws have received little attention in the agricultural economics literature and our article is intended to be a first step in assessing their potential economic implications.

Our primary finding is that termination damages, if passed, may be distortionary and may redistribute rents from processors to growers, but these are not necessary outcomes. Much depends on whether there are contracting frictions which prevent processors from redesigning their contracts to offset the impact of the law. For instance, in the absence of contracting frictions, processors would anticipate having to pay termination damages in certain states of the world and would therefore factor these potential legal liabilities into the contract by discounting the wages offered to growers. When there are no contracting frictions, the law has no impact on either ex ante efficiency or profits, but growers would be protected if they are terminated. Thus, growers would earn less in "good states" of the world, but would be guaranteed by law to receive a severance payment in "bad states" of the world. Moreover, processors would still be able to provide effective incentives to growers to exert high effort, ensuring there would be no ex ante efficiency loss. On balance, this law would protect growers and not create any economic distortions. However, when there are contracting frictions, then processors would not be able to offset the law through contract redesign, raising the possibility of distortions. Processors' costs of managing moral hazard would increase as they would have to provide growers with rents to exert high effort. Consequently, processors may request lower effort. The net effect is that the law would still protect grower investments but at a cost in efficiency. On balance, growers' expected profits would increase while processors' profits would decrease.

While our study represents an initial attempt at examining the Producer Protection Act, it is not without limitations. First, our model is relatively simple and simplifying abstractions are used to add clarity. Richer models incorporating more details could provide added insights. Second, our analysis focuses primarily on qualitative predictions about the distributional and efficiency consequences of the law. It would be useful for researchers to conduct detailed empirical studies to assess the magnitudes of losses and gains from the law.

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### Appendix: Proofs

■ *Proof of Remark 1.* Suppose the principal wants to implement  $e = 1$ . Then the growers's profit is given by (7) under the optimal contract. Note that  $v[w_l + (p_l c / \Delta p)] - I \geq 0$  is necessary for the participation constraint to be satisfied. Now suppose  $vp_l c / \Delta p > I$ . Then it must be true that  $v[w_l + (p_l c / \Delta p)] - I > 0$ , since the LL constraint implies  $w_l \geq 0$ . Therefore, the grower earns positive rents. □

■ *Proof of Proposition 1.* To prove (10) and (11), note from (8) and (9) that the optimal contract payments are:

$$w_l = \max \left\{ 0, \frac{I}{v} - \frac{p_l c}{\Delta p} \right\} \text{ and } w_h = \max \left\{ 0, \frac{I}{v} - \frac{p_l c}{\Delta p} \right\} + \frac{c}{\Delta p}.$$

Substituting these payments into the objective functions (1) and (2) and setting  $e = 1$  yields the desired results. To prove (12) and (13), note that the grower requires no incentives to exert  $e = 0$ . Thus, letting  $w_h = w_l$  and  $e = 0$  and substituting into the grower's objective function yields  $u_{e=0} = vw_l - I$ . But note that a profit-maximizing processor would extract all grower profits whereby  $u_{e=0} = vw_l - I = 0$ , which implies  $w_l = I/v$ . Substituting the latter into the processor's objective function yields  $\pi_{e=0} = v[p_l y - (I/v)] = vp_l y - I$ . □

■ *Proof of Proposition 2.* Note that the processor will implement  $e = 1$  when (a)  $\pi_{e=1} \geq \pi_{e=0}$  and (b)  $\pi_{e=1} \geq 0$ . By Proposition 1, condition (a) is equivalent to

$$v \left[ p_h \left( y - \frac{c}{\Delta p} \right) - \max \left\{ 0, \frac{I}{v} - \frac{p_l c}{\Delta p} \right\} \right] \geq v \left[ p_l y - \frac{I}{v} \right],$$

which, after simplifying, yields the result:

$$\Delta p y \geq c + \max \left\{ 0, \frac{p_l c}{\Delta p} - \frac{I}{v} \right\}.$$

Condition (b) is equivalent to

$$v \left[ p_h \left( y - \frac{c}{\Delta p} \right) - \max \left\{ 0, \frac{I}{v} - \frac{p_l c}{\Delta p} \right\} \right] \geq 0,$$

which, after simplifying, yields the result:

$$\Delta p y \geq c + \max \left\{ \frac{p_l c}{\Delta p}, \frac{I}{v} \right\}. \quad \square$$

■ *Proof of Remark 2.* Suppose the principal wants to implement  $e = 1$ . Since  $D = I$ , the processor chooses to breach and pay damages rather than to continue and avoid paying damages. Thus, the grower's profit is given by (18) under the optimal contract. Note that  $v[w_i + (p_l c / \Delta p)] - vI \geq 0$  is necessary for the participation constraint to be satisfied. Now suppose  $p_l c / \Delta p > I$ . Then it must be true that  $v[w_i + (p_l c / \Delta p)] - vI > 0$  since the LL constraint implies  $w_i \geq 0$ . Therefore, the grower earns positive rents. □

■ *Proof of Proposition 3.* To prove (21) and (22), first set  $e = 1$  and  $\max\{-D, \pi_e^b\} = -D = -I$  in (14). Then substituting optimal contract payments (19) and (20) into (14) yields the desired result for the processor. For the grower, substituting (19) into (18) will yield the desired result. To prove (23) and (24), note that the grower requires no incentives to exert  $e = 0$ . Thus, letting  $w_h = w_l$ ,  $e = 0$ ,  $D = I$ , and  $i = 1$ , and substituting into the grower's objective function (17), yields  $u_{e=0D} = vw_l - vI$ . But a profit-maximizing processor would extract all grower profits whereby  $u_{e=0D} = vw_l - vI = 0$ , which implies  $w_l = I$ . Substituting the latter into the processor's objective function (14) [with  $\max\{-D, \pi_e^b\} = -D = -I$  and  $e = 0$ ] yields the desired result for the processor. □

■ *Proof of Proposition 4.* Note that the processor will implement  $e = 1$  when (a)  $\pi_{e=1D} \geq \pi_{e=0D}$  and (b)  $\pi_{e=1D} \geq 0$ . By Proposition 3, condition (a) is equivalent to

$$v[p_h y - c] - I - \max\left\{0, \frac{vp_l c}{\Delta p} - vI\right\} \geq vp_l y - I,$$

which, after simplifying, yields the result:

$$\Delta p y \geq c + \max\left\{0, \frac{p_l c}{\Delta p} - I\right\}.$$

Condition (b) is equivalent to

$$v[p_h y - c] - I - \max\left\{0, \frac{vp_l c}{\Delta p} - vI\right\} \geq 0,$$

which, after simplifying, yields the result:

$$p_h y \geq c + \max\left\{\frac{p_l c}{\Delta p} + \frac{(1-v)I}{v}, \frac{I}{v}\right\}. \quad \square$$