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**Why Legal Restrictions on Private Contracts
Can Enhance Efficiency**

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Abstract

This paper demonstrates that laws restricting the terms of private contracts can improve efficiency. When parties to a contract are asymmetrically informed, then the better-informed party may attempt to use the terms of the contract to signal information. As a consequence of this signalling, the terms of the contract can be inefficient. By restricting the amount of signalling, contract restrictions can improve efficiency. We apply this insight to show why laws limiting liability in bankruptcy, or, more generally, limiting damages for breach of contract, and laws mandating employer-provided benefits can enhance efficiency.

JEL Classification: 026, 022

entrepreneur with a good project, one way to signal a good project is to promise a large payment to the investor if the project fails. The cost of signalling in this manner is that the entrepreneur exposes herself to considerable risk (e.g., losing her house if the project fails).

Prohibiting signalling (i.e., prohibiting the entrepreneur from exposing herself to excessive risk) may enhance welfare. To see why, note that because of the additional risk, an entrepreneur with a good project might prefer not to signal, if not signalling only made it seem that her project was "average" (i.e., made the investor believe that the probability of failure was between the probability of a good project failing and a bad project failing). The difficulty is that the investor will interpret "not signalling" as evidence that the project is *bad*; and given the choice between looking good (signalling) and looking bad (not signalling), an entrepreneur with a good project will prefer to look good. If, however, signalling is restricted (e.g., by bankruptcy laws), then not signalling is no longer informative. Consequently, the investor will treat all entrepreneurs as if they have an average project. Both types of entrepreneur are better off: an entrepreneur with a bad project now looks average, while an entrepreneur with a good project avoids the additional risks imposed by costly signalling.

To the extent previous work has explored the desirability of contract restrictions, the perspective has been largely extra-economic. For example, Okun (1975) justifies restrictions on equity, moral, and paternalistic grounds. Although these are undoubtedly important grounds, as economists, we would argue that the economic criterion of efficiency is at least as important. Evaluations of contract restrictions based on the efficiency criterion have generally been motivated by a concern for externalities; i.e., without restrictions a contract between A and B will adversely affect C. For example, Chung (1989) demonstrates that the "penalty doctrine" (the courts unwillingness to enforce damage clauses that they deem

punitive) may be desirable because it eliminates undesirable externalities (Rubin (1981) offers another externality-based argument). Concern for externalities is most evident in the antitrust literature; e.g., Aghion and Bolton (1987), who show that restrictions on exclusive-dealing contracts can eliminate the negative externalities suffered by a potential entrant.

What distinguishes our work from previous studies of contract restrictions is that we do not rely on externalities to explain the efficiency of these restrictions. Rather, we rely on informational asymmetries. Because of this, the inefficiencies that exist without contract restrictions are borne by the parties to the contract themselves rather than by a third party.

The idea that the terms of a contract can be used to signal information is a well-known one in contract theory. For example, numerous authors have sought to explain the financial structure of the firm in this way.³ Other recent work includes Aghion and Bolton (1987), where an incumbent monopolist can signal information through the terms of an exclusive-dealing contract; Hermalin (1988, 1990), where contract length is a signal; and Spier (1989), where asking for a risk-sharing contract can signal information. The contribution of this paper is to consider the welfare implications of such signalling, which have been largely ignored in the literature, and to consider the possibility of welfare improvement through legal intervention, which has been similarly overlooked.

We present our model in the next section. For concreteness, the model is presented in terms of a specific example, namely that of an entrepreneur and an investor. However, as we argue in Section 4, our ideas are quite general. We analyze the model in Section 3. There, we focus on situations where restrictions on debt contracts can enhance efficiency. In Section 4 we consider two additional

³ Examples include Leland and Pyle (1977), Ross (1977), and Gertner *et al.* (1988).

applications of our results. We show that laws limiting limiting damages for breach of contract can enhance economic efficiency. We also argue that laws mandating employment benefits, such as maternity leave, may improve efficiency. We conclude with a few remarks and suggestions for further research.

2. The Model

Consider an entrepreneur who needs to raise an exogenously given amount, D , to finance a project and an investor who provides that amount. The entrepreneur's project will either succeed (s) or fail (f). We assume that a project is either "good" (g) or "bad" (b), where a good project is less likely to fail than a bad project. We write this as $F_g < F_b$, where F denotes the probability that the project will fail. The uninformed investor does not know whether the project is good or bad, but he holds a prior probability, θ , that the project is good. The informed entrepreneur knows the quality of her project. For convenience, we will call an entrepreneur with a good (bad) project the good-type (bad-type) entrepreneur.

After learning the quality of her project, the entrepreneur proposes a contract to the investor. We assume that the investor can verify whether the project succeeds or fails, thus a contract is pair of numbers (P_f, P_s) , where P_f is what the entrepreneur pays the investor if the project fails and P_s is what the entrepreneur pays the investor if the project succeeds.⁴

In order that the problem be interesting, we assume that if the project fails, the entrepreneur's total net wealth, W , is *insufficient* to repay the investor (i.e., $W < D$).⁵ Consequently, if the investor is to accept the contract, the promised repayment in the case of success must exceed the amount invested, which in turn must

⁴ As the amount invested is exogenously given, we need not write it explicitly.

⁵ Total net wealth includes the net value of the entrepreneur's human capital. Thus, it is impossible to make the entrepreneur pay more than W .

exceed the the promised repayment in the case of failure (i.e., $P_s > D > P_f$).

Although the contract (P_f, P_s) resembles an equity contract, this formulation, nonetheless, includes debt contracts. A debt contract is an obligation to repay P regardless of the project's success or failure. However, as the promised repayment exceeds the amount borrowed (i.e., $P > D$), this obligation cannot be met if the project fails. Thus, if the project fails, the entrepreneur defaults. In the case of default, the investor can "seize" some amount of the entrepreneur's wealth, \bar{P}_f . Thus, a debt contract is equivalent to the "equity-like" contract (\bar{P}_f, P) .

At the extreme, the investor seizes all the entrepreneur's wealth (i.e., $\bar{P}_f = W$). More realistically, as a variety of laws exempt a portion of a debtor's wealth from seizure by her creditors, we expect $\bar{P}_f < W$. Among the laws we have in mind are state laws that exempt a fixed amount of wealth (e.g., automobiles worth less than \$1500 or a specific portion of the debtor's wages).⁶ Other state laws include exemptions for certain types of property (e.g., the family bible or life insurance policies).⁷ Nor, are these a debtor's only protections: state homestead laws protect the debtor's home from certain classes of creditors;⁸ Title III of the federal Consumer Credit Protection Act provides a minimum exemption of wages from garnishments;⁹ "discharge, as defined by federal bankruptcy law, basically has focused on freeing an individual's future income from the claims of prebankruptcy creditors (Jackson (1986, p. 254));¹⁰ finally, at the extreme, (debt) slavery is

⁶ See Epstein (1985, p. 16).

⁷ See Epstein (1985, p. 16).

⁸ See Epstein (1985).

⁹ However, as Epstein (1985) points out, Title III is not really an exemption law, as it only protects wages from garnishment. Once the wages have been paid, creditors can still attempt to seize them. However, it may in practice serve as an exemption, since it may be impossible for creditors to keep a debtor from spending her wages on groceries (i.e., it may be difficult to take cash from the debtor's hands).

¹⁰ Admittedly, the bankruptcy process does not always end with discharge (the elimination of any further liability on the part of the debtor): there exist grounds

prohibited. Furthermore, in many cases, the protections provided by these laws cannot be waived (see Epstein (1985, p. 18)); thus, these protections are true restrictions on the contracts that can be written (we will return to this point later).

We assume the investor and entrepreneur are risk averse (we could also allow for a risk-neutral investor), with preferences over money that are represented respectively by the continuous, twice-differentiable, increasing, and concave von Neumann-Morgenstern utility functions $v^i(\cdot)$ and $v^e(\cdot)$. We assume that no matter how little money the entrepreneur receives, her utility is never less than \underline{v}^e . The parties' preferences for payments conditional on the probability of failure can be represented by the expected utility functions $U^i(P_f, P_s; F)$ and $U^e(P_f, P_s; F)$ respectively; where

$$U^i(P_f, P_s; F) = Fv^i(P_f) + (1-F)v^i(P_s)$$

and

$$U^e(P_f, P_s; F) = Fv^e(W - P_f) + (1-F)v^e(R - P_s)$$

(where R is the entrepreneur's wealth if the project succeeds).

We illustrate these preferences in Figure 1. The investor's expected utility is increasing as we move to the northeast; that is, the investor likes to receive larger payments. The curve labelled U^i is an indifference curve for the investor. Note that the curve is convex toward the northeast. This is consistent with the investor being risk averse. To see this, recall that because the investor is risk averse, he must be compensated for accepting a gamble (i.e., for accepting a contract in which $P_f \neq P_s$). To keep the investor at the same level of expected utility, the average payment (i.e., $FP_f + (1-F)P_s$) must increase as the gamble becomes riskier

for withholding a discharge and certain debts can be exempted from discharge (see Epstein (1985, pp. 293-312)). As a broad generalization, these grounds often have to do with dishonesty, fraud, or lack of cooperation on the part of the debtor.

(i.e., the more unequal P_f and P_s become). Hence, the convex indifference curves.

The entrepreneur's expected utility is increasing as we move to the southwest; that is, the entrepreneur likes to make smaller payments. The curves labelled b and g are, respectively, indifference curves for the bad type and the good type. Note that they are convex toward the southwest. Again, this is consistent with risk aversion. Note that the indifference curve for the bad type is more steeply sloped than the indifference curve for the good type. This is consistent with the notion that the bad type is more concerned about her payment when the project fails than is the good type, since the bad type is more likely to have to make such a payment. That is, an increase in P_f costs the bad type more, in terms of expected utility, than it costs the good type. Thus, to compensate the bad type fully for an increase in P_f (i.e., to keep her on the same indifference curve), she must be given a larger reduction in P_s than the good type would require to be fully compensated for the same increase in P_f . In particular, note that, whereas the good type prefers the contract labelled C to the contract labelled A , the bad type has exactly opposite preferences.

As already discussed, the investor will accept only contracts in which the payment in case of success exceeds the payment in case of failure. Consequently, as the good type is more likely to succeed, the investor would rather invest with the good-type entrepreneur than with the bad-type entrepreneur; i.e., $U^1(P_f, P_s; F_g) > U^1(P_f, P_s; F_b)$. This is consistent with the notion that the good type is a better risk.

We assume that the entrepreneur offers a contract to the investor on a take-it-or-leave-it basis; that is, the entrepreneur has all the bargaining power. If the investor takes it, then the contract becomes binding on both parties. If the investor leaves it, then the investor gets his reservation utility, \underline{v}^i , and the entrepreneur gets utility \underline{v}^e . With little loss of generality, we can think of the investor's reservation utility as equaling the utility he receives from consuming the

amount invested (i.e., $\underline{v}^1 = v^1(D)$).

In order to rule out "corner solutions", we make the following technical assumption: for both F , if P_s solves

$$Fv^1(W) + (1-F)v^1(P_s) = \underline{v}^1,$$

then

$$\frac{v^{e'}(R-P_s)}{v^{1'}(P_s)} \neq \frac{v^{e'}(0)}{v^{1'}(W)}.$$

As a consequence of this assumption, there are no conditions under which an *efficient* contract commits the entrepreneur to give up all her wealth in the case of failure. This strikes us as an utterly reasonable assumption -- it is hard to imagine that the optimal contract for the entrepreneur would require her to live a life of abject poverty if her project failed. A second technical assumption is that

$$F_b v^1(W) + (1-F_b)v^1(R) > \underline{v}^1.$$

That is, there exists some feasible contract to which the investor would agree even if he knew the entrepreneur had a bad project.

Finally, we assume the structure of this model is known by both parties.

3. Analysis of the Model

Solution Concept

An equilibrium exists in this model when 1) the contract offered by the entrepreneur is optimal for her given the strategy she anticipates the investor is playing; 2) given his beliefs about which type of entrepreneur he is dealing with, the investor's decision to accept or reject a given contract is optimal for him; 3) the investor forms his beliefs in a *reasonable* way; 4) the investor earns no rent (i.e., his expected utility in equilibrium is his reservation utility, \underline{v}^1). By a "reasonable way", we mean that investor's beliefs are formed according to Bayes' Law

when he is offered an equilibrium contract (i.e., a contract that is offered by the entrepreneur with positive probability in the equilibrium being played) and that his beliefs satisfy the Intuitive Criterion (Cho and Kreps (1987)) when he is offered a non-equilibrium contract (i.e., a contract that is a deviation from the equilibrium being played).¹¹

For readers unfamiliar with the Intuitive Criterion, we offer the following description here: An equilibrium satisfies the Intuitive Criterion, if there does not exist a non-equilibrium contract (i.e., a deviation) such that a) relative to her expected equilibrium utility, one type of entrepreneur does worse offering that contract no matter how the investor responds, but such that b) relative to her expected equilibrium utility, the other type does better offering that contract if the investor believes that it is this second type who has offered it. It is felt that "equilibria" in which such deviations (non-equilibrium contracts) exist are unreasonable, because if only one type can possibly benefit from a deviation, then, upon witnessing that deviation, the investor should believe that is the type against whom he is playing; but if that belief makes the deviation desirable for that type, then that type should deviate, which means the "equilibrium" in question is not truly stable.¹²

¹¹ Conditions (1) and (2) plus Bayesian consistency constitute the solution concept Perfect Bayesian Equilibrium (PBE). Conditions (1) - (3) constitute the solution concept of PBE plus the Intuitive Criterion. Condition (4) is a further refinement. Use of (4) is motivated by our belief that given her bargaining power, the entrepreneur should capture all the gains from trade.

¹² As a referee reminded us, our "feeling" is not universal; that is, use of the Intuitive Criterion is controversial with some game theorists. It should be noted, however, that all the equilibria meeting the Intuitive Criterion remain equilibrium under the weaker solution concept of Perfect Bayesian Equilibrium. Thus, the main conclusion of this paper, namely that there can exist equilibria that can be improved by placing restrictions on contracts is *not* dependent on our use of the Intuitive Criterion (or our use of the "no rent" condition (4)).

General Analysis

We define the *symmetric-information contract for the good (bad) type* to be the contract that the good (bad) type entrepreneur would offer if, somehow, the investor was informed that he was dealing with the good (bad) type. That is, the symmetric-information contract is the best (utility-maximizing) contract for the good (bad) type entrepreneur to offer given that the investor is willing to accept the contract when informed that the entrepreneur is the good (bad) type. [Given our assumptions the symmetric-information contract for each type is unique.] As we are assuming that the investor is not informed about the entrepreneur's type, it will generally be true that the investor will not accept the symmetric-information contract for the good type. The reason for this is that the uninformed investor is worried about being fooled by the bad type; i.e., he is worried about unknowingly accepting a contract from the bad type that does not adequately compensate him for the additional risk of investing with the bad type. Furthermore, this is not an idle worry on the part of the investor: as the bad type would like to avoid compensating the investor for that additional risk, the bad type has an incentive to pretend to be the good type by offering the same contract offered by the good type. Loosely, the bad type generally would do better mimicking the good type by offering the symmetric-information contract for the good type than by offering any other contract that the investor would accept in equilibrium. Thus, generally, there is no equilibrium in which the good type can offer her symmetric-information contract and have it accepted.

On the other hand, the investor is always willing to accept the symmetric-information contract for the bad type -- either the bad type has offered it, in which case the investor is indifferent between accepting and rejecting it, or the good type has offered it, in which case the investor gets the compensation for investing with the bad type, while enjoying the low risk of investing with the good

type. A consequence of this insight is that, in equilibrium, the bad type's expected utility must be at least as great as it would be if she offered her symmetric-information contract (since otherwise she could successfully deviate by offering her symmetric-information contract).

Much of our analysis is concerned with *pooling equilibria*; that is, equilibria in which both types of entrepreneur offer the same contract. Therefore, it proves useful to define the *pooling line*, which is the set of contracts that the investor would be indifferent between accepting and rejecting, if he thought that *both* types were offering those contracts. Formally, the pooling line is the solutions to

$$\theta U^1(P_f, P_s; F_g) + (1-\theta)U^1(P_f, P_s; F_b) = v^1.$$

We denote the pooling line by the function $P_s(P_f)$. An illustration of the pooling line is given in Figure 2.

As noted above, P_f is restricted to lie below some bound, \bar{P}_f , where \bar{P}_f is defined either by the entrepreneur's wealth in case of failure or by legal protections. The consequence of such a restriction is considered in the following proposition (proofs are found in Appendix A).

Proposition 1: *If P_f is restricted to be at most \bar{P}_f , and if the bad type prefers $(\bar{P}_f, P_s(\bar{P}_f))$ to her symmetric-information contract, then the unique equilibrium is the pooling equilibrium in which both types of entrepreneur offer the contract $(\bar{P}_f, P_s(\bar{P}_f))$.*

Intuitively, the good-type entrepreneur wants to signal that she has a good project. As suggested in the introduction, she can do this by promising a large payment should the project fail. However, her ability to do so is constrained by the maximum payment, \bar{P}_f . Thus, she may not have "enough room" to signal that her project is good; that is, even if she offered a contract with the maximum payment in case of failure, a bad-type entrepreneur would prefer to mimic her. Consequently, the good

type may be compelled to accept pooling with the bad type at $(\bar{P}_f, P_s(\bar{P}_f))$.

Further intuition for Proposition 1 can be found in Figure 2. The contract $(\bar{P}_f, P_s(\bar{P}_f))$ lies below the bad type's indifference curve, labelled b^* , through the bad type's symmetric-information contract, labelled B^b (recall the entrepreneur's utility is increasing toward the southwest). Thus, the bad type does better to mimic (pool with) the good type at $(\bar{P}_f, P_s(\bar{P}_f))$ than to reveal herself to be the bad type. To see this, recall, by definition, the best the bad type can do if she reveals herself is to offer her symmetric-information contract. Thus, if the good type offers a contract that lies below the bad type's indifference curve through B^b , then the bad type does better to mimic the good type than to reveal herself. Hence, since the good type will, in equilibrium, indeed wish to offer a contract below that indifference curve, the only equilibrium is a *pooling* equilibrium.

Consequently, the question becomes what contract will they both offer? Not any contract on the pooling line can be part of a *reasonable* pooling equilibrium. For example, consider the contract labelled A in Figure 2. The indifference curves for the two types through A have been drawn in and labelled b and g accordingly. To see why it is *not* a solution for both types to offer A , suppose that they are supposed to offer A . Consider, then, what would happen if the good type "signalled a little bit" by offering the contract labelled C (note C has more P_f and less P_s than A). As C lies above b , the bad type would have no incentive to deviate in this manner, no matter who the investor thought she was. On the other hand, if the investor thought that C had been offered by the good type, then he would sign C . He will, in fact, accept any contract on, or above, U_g (see Figure 2) that he thinks was offered by the good type, where U_g is the locus of contracts which the investor is indifferent between accepting or rejecting given he believes the contracts were offered by the good type (i.e., U_g is the locus of contracts satisfying $U^1(P_f, P_s; F_g) = v^1$). Furthermore, as C lies *below* g , the good type does better offering C if the investor

will accept C . As we have argued, it is then reasonable to expect the good type to deviate by offering C and the investor to accept C . This rules out A as an equilibrium.

It should be clear that we can repeat this argument for any contract, other than $\left(\bar{P}_f, P_s(\bar{P}_f)\right)$, which lies on the pooling line. The argument breaks down for $\left(\bar{P}_f, P_s(\bar{P}_f)\right)$ because there is no room left to signal; i.e., a deviation analogous to offering contract C would entail offering a contract in which $P_f > \bar{P}_f$, which violates the restriction. Hence, $\left(\bar{P}_f, P_s(\bar{P}_f)\right)$ is not ruled out. Therefore, by process of elimination, $\left(\bar{P}_f, P_s(\bar{P}_f)\right)$ is the only contract that will be offered.

Recall that a contract in which $P_f = \bar{P}_f$ can be thought of as being a debt contract. Thus, we can view Proposition 1 as giving the conditions for the unique equilibrium to be a pooling equilibrium in which both types offer debt contracts.

As suggested in the introduction, we can have equilibria in which, because of the desire to signal good information, the entrepreneur is exposed to inefficiently excessive risk (e.g., consider Proposition 1 when $\bar{P}_f = W$). To eliminate those equilibria and reach more efficient equilibria, we need to limit the entrepreneur's ability to signal; that is, we need to limit P_f . Sufficient conditions for restrictions on P_f to improve efficiency are given by the following proposition. We call equilibria without legal restrictions (i.e., where wealth is the only restriction) *without-a-law equilibria*.

Proposition 2: *If*

a) *there exists a contract on the pooling line that the good type likes as well as the contract she offers in the without-a-law equilibrium,*

and

b) *if the bad type is indifferent between the contract she is to offer in the without-a-law equilibrium and the contract the good type is to offer in the without-a-law equilibrium,*

then there exist restrictions on P_f that improve efficiency.

Proposition 2 is illustrated in Figure 3. The curve labelled b is the bad type's indifference curve through her without-a-law equilibrium contract, E^b , and through the good type's without-a-law equilibrium contract, E^g , (thus, condition (b) is met). The curve labelled g is the good type's indifference curve through her without-a-law equilibrium contract. It intersects $P_s(P_f)$ at (\hat{P}_f, \hat{P}_s) (thus, condition (a) is met). Clearly pooling at (\hat{P}_f, \hat{P}_s) improves efficiency: the good type is indifferent between pooling at (\hat{P}_f, \hat{P}_s) and her without-a-law equilibrium contract, the bad type strictly prefers pooling at (\hat{P}_f, \hat{P}_s) to her without-a-law equilibrium contract, and the investor's expected utility is v^1 , the same as in the without-a-law equilibrium (recall that we are restricting attention to equilibria in which the investor earns no rent). The only thing left to check is that a law requiring $P_f \leq \hat{P}_f$ leads to a pooling equilibrium at (\hat{P}_f, \hat{P}_s) . As the bad type always has the option of revealing herself and offered her symmetric-information contract, her without-a-law equilibrium utility must be at least equal to what she would receive from offering her symmetric-information contract. We have derived that she prefers (\hat{P}_f, \hat{P}_s) to her without-a-law equilibrium contract. Hence, by transitivity, we have that the bad type prefers (\hat{P}_f, \hat{P}_s) to her symmetric-information contract; thus, by Proposition 1, the new equilibrium is indeed pooling at (\hat{P}_f, \hat{P}_s) .

It is clear from Figure 3 that \hat{P}_f is not the only restriction that would improve efficiency. For example, consider the restriction P_f^* . By the same arguments as above, a law restricting $P_f \leq P_f^*$ would lead to a pooling equilibrium at (P_f^*, P_s^*) . As pictured, this is a more efficient equilibrium than the without-a-law equilibrium (it is also a more efficient equilibrium than pooling at (\hat{P}_f, \hat{P}_s)). What this discussion suggests is that there is a (possibly wide) range of restrictions that will improve efficiency. Let (P_f^E, P_s^E) be the without-a-law equilibrium contract (pictured as E^g) offered by the good type. Let \underline{P}_f be the smaller of the two

solutions (assuming two solutions exist) to

$$U^e(P_f, P_s(P_f); F_g) = U^e(P_f^E, P_s^E; F_g).$$

That is, the good type is indifferent between $(P_f, P_s(P_f))$ and (P_f^E, P_s^E) . Then, any restriction between P_f and \hat{P}_f increases the expected utility of both types. Finally, if there is only one solution, then all restrictions that are more stringent than \hat{P}_f increase efficiency.

In the equilibria *with* these restrictions, the restrictions are binding. As before, this means that we may interpret the equilibrium contracts as debt contracts; that is, we can view, say, (\hat{P}_f, \hat{P}_s) as the debt contract that obligates the entrepreneur to repay \hat{P}_s . We can view the restriction \hat{P}_f as the amount of her wealth the investor can seize should she default, where \hat{P}_f is fixed by the various statutes that protect debtors.

The reader should recognize that these restrictions are necessary for efficient equilibria to exist. *Without* a law, it is impossible for, say, (\hat{P}_f, \hat{P}_s) , to be offered in equilibrium; the good type would attempt to "signal away" from this contract by offering deviations like C in Figure 2. So without a law, given that the investor's beliefs are reasonable, the investor will interpret any offer of (\hat{P}_f, \hat{P}_s) as having been made by the bad type, and hence he will reject the offer. This argument shows why it is important that debtors not be able to waive contractually the protections afforded them by the law; if they could waive them, then they would signal that they were good, and the benefits of these protections would be lost.

Although Proposition 2 suggests that laws restricting P_f can improve efficiency, we have not yet shown that the two conditions of Proposition 2 hold for any without-a-law equilibrium. The rest of this section is devoted to finding without-a-law equilibria that satisfy these conditions; i.e., equilibria in which the introduction of restrictions on P_f will improve efficiency.

To complete this task, we divide the analysis into three cases. The three cases

are defined by the type of the without-a-law equilibrium: is the without-a-law equilibrium pooling, separating (the two types offer different contracts), or hybrid (the bad type systematically randomizes between pooling and separating)? The first two cases are treated in the text. The third, which is technically more demanding, is relegated to Appendix B.

Analysis of Case 1: Pooling Equilibrium.

As suggested by Proposition 1, the condition for the without-a-law equilibrium to be pooling is that $(W, P_s(W))$ lie below the bad type's indifference curve through her symmetric-information contract. This condition will hold when the entrepreneur is not too risk averse (i.e., her indifference curves are not too convex); when the bad type is relatively likely to succeed (i.e., her indifference curves are not too steeply sloped); and/or when the symmetric information contract for the bad type already exposes her to considerable risk (i.e., P_f is near W). A pooling equilibrium is illustrated in Figure 4 (B^b again denotes the bad type's symmetric-information contract). Formally,

Corollary 1: *If the bad type prefers $(W, P_s(W))$ to her symmetric-information contract, then, given no restrictions on P_f (other than $P_f \leq W$), the unique equilibrium is for both types of entrepreneur to offer the contract $(W, P_s(W))$.*

Proof: Since the bad type prefers $(W, P_s(W))$ to her symmetric information contract, the conditions of Proposition 1 are satisfied (with $\bar{P}_f = W$). ■

Not only is the equilibrium pooling, but it is pooling at the *largest* possible value of P_f . That is, both types' liability in case of failure is as large as possible. Like Proposition 1, the good type runs out of room to signal. Consequently, she is forced to accept pooling with the bad type. Note that this is,

essentially, the worst of all possible outcomes: not only is the good type forced to pool with the bad type, and thus forced to look average rather than good, but in her vain attempt to look good, the good type also exposes herself to the maximum liability. Given that she is forced to look average, the good type entrepreneur would rather offer a contract that exposed her to less liability. Unfortunately, such an offer (which is analogous to offering A in Figure 2) will be interpreted by the investor as having been made by the bad type, and thus it will be rejected.

Now, we will show how in Case 1 there always exists a restriction on P_f that improves efficiency:

Corollary 2: *In Case 1, there exist restrictions on P_f that improve efficiency.*

Proof: It is straightforward to show that the two conditions of Proposition 2 are met: (a) is met since the without-a-law equilibrium contract offered by the good type is on the pooling line and (b) is met since the without-a-law equilibrium is pooling.

■

The intuition is clear. By assumption, the optimal contract cannot commit the entrepreneur to forfeit all her wealth in case of failure, thus there must exist a more efficient pooling contract than $(W, P_s(W))$. From Figure 4, it should be clear that efficiency is improved by any restriction between \underline{P}_f and W . Consequently, even a slight restriction (e.g., \hat{P}_f close to W) helps. Intuitively, as the without-a-law equilibrium is pooling at a point of extreme liability for the entrepreneur, even a slight amount of protection is valuable.

Analysis of Case 2: Separating Equilibrium

Define P_s^g as the solution to

$$U^1(W, P_s^g; F_g) = \underline{v}^1.$$

Consequently, the investor would accept (W, P_s^g) if he thought it had been offered by the good-type entrepreneur. Graphically, (W, P_s^g) is the intersection of the vertical line $P_f = W$ and U_g , where U_g is the locus of contracts that the investor is just indifferent between accepting and rejecting if he believes the contracts were offered by the good type (see Figure 5a).

For a separating equilibrium to exist, it must be the bad type prefers her symmetric-information contract to (W, P_s^g) . This will occur when the entrepreneur is very risk averse (i.e., her indifference curves are highly convex); when the bad type is relatively likely to fail (i.e., her indifference curves are steeply sloped); and/or when the bad type's symmetric information contract does not expose her to much risk (i.e., P_f is much less than W). In this is the case, we have

Proposition 3: *If the bad type prefers her symmetric-information contract to (W, P_s^g) , then, given no restrictions on P_f , the unique solution consists of the bad type offering her symmetric-information contract and the good type offering the best separating contract, where the best separating contract is the contract that maximizes her utility subject to the constraints that the bad type not wish to mimic her and that the investor be willing to accept that contract given he believes only the good type offers it.*

As the equilibrium is separating (both types are revealed), the bad type offers the best contract for her given that she is revealed to be bad (i.e., her symmetric-information contract, B^b). The good type offers the best contract for her given that she is revealed to be good, and given that the bad type should have no incentive to deviate by mimicking the good type. If both these constraints are binding, then the equilibrium is as pictured in Figure 5a: the good type offers the contract defined by the intersection of the bad type's indifference curve through B^b (the curve labelled b) and the investor's indifference curve defined by

$$U^i(P_f, P_s; F_g) = v^i$$

(the curve labelled U_g). This point of intersection, the best separating contract, is labelled B^g . If the constraints are not both binding, then it will be the "no-mimicking" (incentive compatibility) constraint that is not binding. The equilibrium is then as pictured in Figure 5b: the good type offers the contract defined by the tangency between her indifference curve (labelled g) and the investor's indifference curve (labelled U_g). Note in Figure 5b that the best separating contract, B^g , is also the symmetric-information contract for the good type.

The equilibrium of Figure 5b is to be expected when the failure probability for the bad type is large (i.e., near 1) and the failure probability for the good type is small (i.e., near 0); under those circumstances, the bad type's indifference curves are very steep (P_f matters much more than P_s) and the good type's indifference curves are very flat (P_s matters much more than P_f). Otherwise, if the failure probabilities for the two types are close to one another, then the equilibrium will resemble Figure 5a.

Unlike Case 1, the efficiency effects of restrictions on P_f are ambiguous in Case 2. It is possible, for example, that the introduction of a law such as $P_f \leq P_f^*$ could reduce efficiency. This would be the situation, for instance, in the equilibrium illustrated by Figure 5b: as the equilibrium of Figure 5b maximizes the expected utility of the entrepreneur given the constraint that the expected utility of the investor not be less than his reservation utility, a (binding) law could serve only to reduce *ex ante* efficiency.

On the other hand, as Spence (1974) noted, there exist separating equilibria that yield lower expected utility for the entrepreneur than pooling equilibria. Thus, there exist conditions under which the introduction of restrictions improves efficiency in Case 2. For example, as drawn, efficiency would be improved by the

restriction $P_f \leq P_f^*$ in Figure 5a: the contract (P_f^*, P_s^*) dominates both B^b and B^g . In fact, whenever the good type's indifference curve through her without-a-law equilibrium contract intersects the pooling line (as in Figure 5a), then introduction of restrictions like $P_f \leq P_f^*$ will improve efficiency.

Corollary 3: *In Case 2, if there exists a contract on the pooling line such that the good type is indifferent between that contract and her best separating contract, then there exists a restriction on P_f that improves efficiency.*

Proof: From the statement of the corollary, condition (a) of Proposition 2 is satisfied. Because the good type's indifference curve through B^g intersects the pooling line, the no-mimicking constraint must be binding; i.e., the bad type is indifferent between her symmetric-information contract and B^g . Therefore, condition (b) is met. ■

Again, there is a range of restrictions that will improve efficiency; the boundary of which is fixed by the two points of intersection between the indifference curve g and the pooling line (see Figure 5a).

4. Generalizations and Other Applications

We wish to emphasize that our analysis is not limited to the situation of an entrepreneur raising funds for a project. To see this, let the entrepreneur be any informed party, the investor be any uninformed party, and P_f and P_s be any contract terms. Provided 1) the parties have opposite preferences over the contract terms; i.e., for each term, one party would prefer an increase in that term while the other party would prefer a decrease; provided 2) the parties have convex preferences over the terms of the contract; provided 3) the marginal rate of substitution between the terms of the contract varies systematically across the different types of the

informed party; and provided 4) the informed party's private information remains private, or, if it is subsequently learned by the uninformed party, contracts cannot be made fully contingent on that information; then the analysis presented here will be applicable.¹³ As most contracting problems arise because of opposite preferences; as convex preferences are a standard assumption about preferences; and as different marginal rates of substitution are a standard assumption in adverse selection problems, one should expect the first three conditions to be met by most problems of contracting under asymmetric information. The last condition is very reasonable, when the private information is a probability or distribution (as in the examples given here). It may be less reasonable, if the private information is something like quality which the uninformed party learns *ex post* and which may be verifiable before a judge (or other source of adjudication). In that case, the adverse selection problem may be resolved through methods such as warranties or verifiable disclosures by the informed party.

An Application: Limitations on Penalties for Breach of Contract

The issue of which damage measures for breach of contract should be imposed is a well-studied one.¹⁴ Although it is certainly worthwhile to compare the various measures commonly used, as previous work has done, it is also important to ask why it is desirable to use these measures, and not measures that the parties to the contract

¹³ The existence of a boundary (e.g., W) is not necessary for our analysis (we only included it to extend the generality of our analysis). If there is no boundary, then the only equilibria satisfying our solution concept are separating equilibria. [We will not repeat the proof here, as it follows straightforwardly from Cho and Kreps (1987).] Thus all equilibria resemble Figure 5a or Figure 5b. As discussed above, the introduction of restrictions when the equilibrium resembles Figure 5b reduces efficiency. However, as shown in Figure 5a and proved in Corollary 3, when the equilibrium resembles Figure 5a, then restrictions will improve efficiency. Thus, our insight that restrictions can improve efficiency is *not* dependent on the existence of a boundary.

¹⁴ A partial list of papers in this area includes Shavell (1980, 1984), Rea (1982, 1984), Rogerson (1984), Leitzel (1989), and Chung (1989).

might choose themselves. As we have shown, an answer is that, without laws fixing or limiting damages, inefficient levels of damages could arise.

In a world of *symmetric* information the optimal remedy for breach must be *specific performance* (i.e., under the threat of contempt of court, the parties to the contract are forced to carry out its terms).¹⁵ To see this, imagine the informed party is supposed to do some task (let F be the probability that she fails to do it). In a world of symmetric information (i.e., F is known by both parties), the optimal contract will specify transfers, P_f and P_s , between the two parties contingent on whether the informed party failed or succeeded in doing the task. That is, there will be one level of transfer, P_s , if the task is done and another, P_f , if the task is not done. *Breach* in this model would occur *only if* the amount of the transfer was not what the contract had specified for the realization of the task. That is, failure to complete the task does *not* constitute breach. Clearly, the only role for the law (the courts) is to enforce the proper transfers (i.e., the optimal remedy is specific performance).

With *asymmetric* information, there exist situations in which the levels of the transfers are set inefficiently due to signalling (e.g., the good type attempts to signal that she is likely to complete the task by promising to make an inefficiently large transfer to the uninformed party if she fails).¹⁶ Now, as we have seen,

¹⁵ Our thinking here was influenced greatly by conversations with Michael Katz.

¹⁶ We mean inefficiently large in the sense of our analysis in Section 3. This is important, as Rea (1984) argues that even with asymmetric information, the informed party would never offer a transfer larger than required to fully insure the uninformed party (i.e., a transfer large enough to equalize the uninformed party's utility between the state in which the task is done and the state in which it is not done). Although this may well be the case, even providing full insurance could represent an inefficiently large transfer if the informed party is risk averse. Furthermore, by changing the assumptions underlying Rea (1984), one can have equilibrium transfers in excess of the amount necessary to equalize the utilities in the two states: for example, imagine that probability of failure is inversely related to some uncontractable quality measure, Q , associated with the task (i.e., $Q_g > Q_b$), then it is quite easy to construct a model in which, as a consequence of

specific performance may no longer be optimal. Instead, optimality may require that the law *not* enforce contracts calling for inefficiently large transfers (i.e., the law should, and indeed does, adopt a penalty doctrine or otherwise consider "excessively" large transfers as unconscionable (see Friedman (1981)). Of course, what constitutes an excessively large transfer is relative, so the law may be compelled to adopt a standard such as *reliance damages*, *expectation damages*, or *restitution* in order to establish what constitutes reasonable transfers. That is, an economic justification for these standards is that they transform inefficient equilibria into more efficient equilibria.

We note that our justification for these standards differs from the one often discussed by legal scholars, namely that the problem with excessive penalties is that they may cause the party who will receive the penalty to attempt to induce breach (see, e.g., Clarkson *et al* (1978)). Although this sort of moral hazard is undoubtedly a real concern, it is unclear to us why it should be a concern of the courts and not of the parties to the contract. That is, the parties to the contract should anticipate this moral hazard problem and, thus, should take steps to ameliorate it (including, possibly, not having excessive penalty clauses). Given this, it is unclear to us why the courts should interfere if the parties nonetheless choose to include such clauses. To repeat our earlier point, given that pure moral hazard represents an (*ex ante*) *symmetric* information problem, we believe in this case that efficiency requires that contracts be enforced as written. Only if excessive penalty clauses are the consequence of *asymmetric* information, should the courts interfere.

trying to signal good quality, the uninformed party is over-insured by the good type.

An Application: Employer Provided Benefits

Laws that require employers to provide certain benefits to employees, such as health insurance, maternity leave, or child care, generally (and historically) are *not* supported by economists.¹⁷ The argument against these proposals is that if it were efficient for employers to provide these benefits, then employer and employee would include these benefits in the employment contract. Thus, if contracts do not include these benefits, it cannot have been efficient for employers to provide these benefits.

Our analysis shows, however, that this argument may not hold water. For example, let P_f be the number of weeks of maternity leave granted by the employer and let P_s be the employee's wage.¹⁸ The employee knows the probability, F , that she will become pregnant (i.e., the employee is the informed party). The lower the employee's probability of becoming pregnant, the more willing she is to trade off maternity leave for a higher wage. As childless workers are more productive (e.g., they have a lower absentee rate), the employer prefers to hire employees who are unlikely to become pregnant (the good type) over employees who are likely to become pregnant (the bad type), and he is willing to pay the good type more. Consequently, in equilibrium, the weeks of maternity leave provided by the employer could be inefficiently low; e.g., the good-type employee seeks to signal that she is unlikely to become pregnant by asking for no maternity leave privileges, and the bad-type employee does better to mimic than to reveal herself.¹⁹ Thus, laws mandating

¹⁷ For example, see Gary Becker's editorial, "If it Smells Like a Tax and Bites Like a Tax ...", in *Business Week*, August 22, 1988. Also see Walker (1883, pp. 461-465) for a discussion of the opposition by 19th English economists to factory legislation in England.

¹⁸ Note, here, the informed party's (the employee's) expected utility is increasing as we move toward the northeast, while the uninformed party's (the employer's) expected utility is decreasing as we move toward the southwest. Otherwise the analysis is the same as in Section 3.

¹⁹ Admittedly, in most employer-employee relationships, the employer offers the

maternity leave could increase efficiency.

In passing, we note that we more often see employer-provided benefits in unionized firms than in non-unionized firms. Our model can explain this phenomenon: because the union seeks one contract for all its members, collective bargaining essentially pools the different types of workers. Consequently, if the union seeks to maximize the average utility of its members, it will seek the most efficient pooling contract. In contrast, under individual bargaining, the individual is tempted to signal her own type through the terms of the contract, and, as we saw in Section 3, this leads to inefficiencies. Thus, because collective bargaining eliminates distortionary signalling, collective bargaining can yield more efficient outcomes than individual bargaining.

5. Conclusions

Parties to a contract may enter into inefficient contracts due to asymmetric information. Under asymmetric information, a contract plays two roles. First, it sets the terms of trade, and, second, it can reveal private information. As it is the first role that determines the efficiency of a contract, the second role can only lead to inefficiency. Restrictions on contracts can increase efficiency if they limit the signalling role without adversely affecting the terms of trade role.

We applied this insight to three situations. First, we showed that laws that protect debtors can be desirable from the perspective of economic efficiency. Without such laws, the debtor may signal that her probability of default is small by not using the contract to limit her liability. Hence, if the parties are risk averse, efficiency can be lost. Laws that limit her liability eliminate inefficient

contracts. However, provided employers compete for employees, informational asymmetries will still lead to inefficient contracts even when the uninformed employers offer the contracts. See Hermalin (1988, 1990) for examples in the context of on-the-job training.

signalling, while insuring efficient terms of trade.

The second application was to endogenously set damages. Here, the informed party may attempt to signal the likelihood that she will carry out a given task by promising an excessively large transfer to the uninformed party if she fails to carry it out. Laws that prohibit such punitive damages, or otherwise view them as unconscionable, eliminate this signalling, which may improve efficiency.

Finally, we applied our insights to employment relationships, specifically the mandated provision of benefits by employers. Women, for example, might seek to signal that they are unlikely to have children by not asking for provisions for maternity leave in their contracts. Again, this type of signalling reduces efficiency. Mandated maternity leave eliminates such inefficient signalling and induces efficient terms of trade.

By no means, however, does our paper represent the last word on contract restrictions; theoretical and empirical questions remain. One set of theoretical questions is whether restrictions can be welfare improving under alternative assumptions about the *ex ante* market. Here, we have assumed a bilateral monopoly in which the informed party (e.g., the entrepreneur) has all the bargaining power. Clearly, other assumptions could be considered. Furthermore, our results are sensitive to our assumption; for example, in a bilateral monopoly in which the uninformed party (e.g., the investor) had the bargaining power and offered contracts, restrictions could not improve efficiency: as the uninformed party captures all the gains to trade, he will completely internalize the cost of inducing the different types of informed party to reveal themselves. Consequently, the amount of revelation will be optimal from his perspective, and, thus, there is no scope for improvement through restrictions. In contrast, under our assumption, the bad type does *not* internalize the cost (externality) she imposes on the good type, so there is scope for improvement through restrictions.

One could also drop the assumption of a bilateral monopoly and consider a one-sided monopoly. If the informed party is the monopoly party and she makes offers (either sequentially or to the first taker), then the results of this paper continue to hold -- the analysis is modified only minimally. If the informed party is the monopoly party, but competitive uninformed parties make the offers, then the model will resemble a Rothschild-Stiglitz (1976) model. The model will also resemble a Rothschild-Stiglitz model if competitive uninformed parties make offers to a number of informed parties. As is well-known, in such a model, forced pooling in which the informed party is compelled to trade can improve efficiency (e.g., the adverse selection problems inherent in a private annuity market are "cured" by a mandatory social security system). Thus, restrictions that induce pooling can be part of a package of laws (the other part being mandatory trade) that can improve efficiency in such models.

By focusing on a single trading relationship, we have ignored the problems that arise when a given set of laws (restrictions) apply across a variety of trading relationships. For example, different entrepreneurs have different levels of wealth in case of failure, they have different levels of risk aversion, and they borrow from different kinds of investors. How should restrictions be set to improve efficiency for all these relationships? Can they be set to improve efficiency for *all* relationships, or must a trade-off be made between improving efficiency for some while reducing it for others? The answer to these questions depends on the ability to write restrictions so that they are flexible. To some extent, this flexibility can be incorporated into "rigid" laws; e.g., protection for debtors that guarantee that a debtor's wealth cannot be less than some fixed amount is a flexible restriction in the sense that it does not depend on the debtor's wealth at the time of default. In other settings, however, flexibility requires the restrictions to be contingent on the relationship; e.g., the determination of whether a penalty is

Appendix A: Proofs

For the purposes of this appendix, we denote the symmetric-information contract for the bad type as (P_f^b, P_s^b) . We begin with a general lemma:

Lemma: *Let P_f be restricted to be not more than \bar{P}_f (i.e., $P_f \leq \bar{P}_f$). Then, in equilibrium, if the two types offer the same contract with positive probability, then that contract must specify $P_f = \bar{P}_f$.*

Proof: Suppose not. Let (P_f, P_s) be a contract that both types offer with positive probability in equilibrium, with $P_f < \bar{P}_f$. Since both types offer (P_f, P_s) with positive probability, they must each like (P_f, P_s) as well as any other contract they offer with positive probability. Consider the deviation $(P_f + \epsilon, P_s - \delta)$, where ϵ and δ are positive. As the investor is willing to accept (P_f, P_s) , he must be willing to accept $(P_f + \epsilon, P_s - \delta)$ for sufficiently small ϵ and δ , if he believes only the good type has deviated in this fashion. Furthermore, we can choose ϵ to insure $P_f + \epsilon \leq \bar{P}_f$. Finally, we can choose ϵ and δ , such that

$$U^e(P_f + \epsilon, P_s - \delta; F_b) < U^e(P_f, P_s; F_b),$$

and

$$U^e(P_f + \epsilon, P_s - \delta; F_g) > U^e(P_f, P_s; F_g).$$

But then this equilibrium violates the Intuitive Criterion: the bad type has no incentive to make this deviation, no matter what the investor will believe, but the good type does, given that the investor will accept, and given that the investor recognizes this, he will accept. ■

Proof of Proposition 1

First, the following is a PBE: both types of entrepreneur offer $\left[\bar{P}_f, P_s(\bar{P}_f)\right]$; the investor believes the probability that he is playing against the good type is θ , if he is offered $\left[\bar{P}_f, P_s(\bar{P}_f)\right]$, and he believes it is zero, if he is offered another

contract; finally, given his beliefs, the investor accepts any contract that yields him expected utility of at least \underline{v}^1 . It is clear that all parties are playing optimally given their beliefs and that on the equilibrium path beliefs are consistent with Bayes' Theorem. This PBE also satisfies the Intuitive Criterion: any deviation the bad type likes, the good type also likes, and there is no *feasible* deviation that good type likes that the bad type does not also like. Clearly this PBE also satisfies our "no rent" condition.

Now, we consider uniqueness. First, we rule out separating equilibria. No matter what beliefs he holds, the investor will always accept $(P_f^b, P_s^b + \epsilon)$ for any $\epsilon > 0$, thus the bad type's utility in a separating equilibrium must be

$$U^e(P_f^b, P_s^b; F_b).$$

Thus, if the good type offers (P'_f, P'_s) , then incentive compatibility requires

$$U^e(P'_f, P'_s; F_b) \leq U^e(P_f^b, P_s^b; F_b). \quad (\text{A.1})$$

However, this equilibrium is dominated by pooling at $(\bar{P}_f, P_s(\bar{P}_f))$: by assumption,

$$U^e(\bar{P}_f, P_s(\bar{P}_f); F_b) > U^e(P_f^b, P_s^b; F_b).$$

Furthermore, as $P_f \leq \bar{P}_f$, for any (P'_f, P'_s) satisfying (A.1),

$$U^e(P'_f, P'_s; F_g) < U^e(\bar{P}_f, P_s(\bar{P}_f); F_g).$$

So, the *ex ante* expected utility for the entrepreneur is less in any separating equilibrium than under the pooling equilibrium. But this means that the investor must be earning an expected rent, which violates our "no rent" condition. Thus, separating equilibria are ruled out by our "no rent" condition.

This leaves only the possibilities of other pooling equilibria and hybrid equilibria. From Lemma 1, the only pooling equilibria occur at $P_f = \bar{P}_f$; as $(\bar{P}_f, P_s(\bar{P}_f))$ is the only such equilibria that does not leave a rent to the investor, the only possible pooling equilibrium is at $(\bar{P}_f, P_s(\bar{P}_f))$. From Lemma 1, in a hybrid equilibrium both types must offer a contract of the form (\bar{P}_f, P_s) with positive probability. Suppose the good type randomizes between this contract and (\hat{P}_f, \hat{P}_s) . As

the good type is willing to randomize, we have

$$U^e(\bar{P}_f, P_s; F_g) = U^e(\hat{P}_f, \hat{P}_s; F_g).$$

But, we would then have

$$U^e(\bar{P}_f, P_s; F_b) < U^e(\hat{P}_f, \hat{P}_s; F_b).$$

So the bad type would not have offered (\bar{P}_f, P_s) . Suppose the bad type randomizes between (\bar{P}_f, P_s) and some other contract. Since this other contract reveals the bad type, this other contract must be (P_f^b, P_s^b) . But by the argument used to eliminate separating equilibria, we know any such hybrid equilibrium is dominated by pooling at $(\bar{P}_f, P_s(\bar{P}_f))$, and thus leaves a rent to the investor. Thus, the pooling equilibrium at $(\bar{P}_f, P_s(\bar{P}_f))$ is unique. ■

Proof of Proposition 2

The discussion in the text proves the proposition. ■

Proof of Proposition 3

Let B^g be the best separating contract. Given our assumptions, B^g is unique.

The following is a PBE: the good type offers B^g and the bad type offers (P_f^b, P_s^b) ; the uninformed party (investor) believes his opponent is the good type, if he is offered B^g and he believes his opponent is the bad type, if he is offered a contract other than B^g ; finally, given his beliefs, the uninformed party accepts any contract that yields him expected utility of at least \underline{v}^1 . It is clear that all parties are playing optimally given their beliefs and that on the equilibrium path beliefs are consistent with Bayes' Theorem. Using arguments found in Cho and Kreps (1987), it can be shown that this is only equilibrium satisfying the Intuitive Criterion. Furthermore, as discussed in the text, the investor is left no rent in this equilibrium. Thus, it is the unique equilibrium. ■

Appendix B: Analysis of Case 3

If the bad type prefers (P_f^b, P_s^b) to $(W, P_s(W))$ and if she prefers (W, P_s^g) to (P_f^b, P_s^b) , the only equilibrium is a *hybrid* equilibrium (the bad type systematically randomizes between pooling with the good type and separating from the good type). Note that Case 3 is the complement of Cases 1 and 2.

In a hybrid equilibrium, the good type always offers (W, P_s^H) (P_s^H will be defined later) and the bad type offers (W, P_s^H) with probability q and (P_f^b, P_s^b) with probability $1 - q$. Recall that the investor's beliefs must be consistent with Bayes' Theorem. Thus, his posterior probability, $\mu(q)$, that it is the good type given he is offered (W, P_s^H) is

$$\mu(q) = \frac{\theta}{q(1-\theta) + \theta}.$$

Let P_s^H solve

$$U^e(W, P_s^H; F_b) = U^e(P_f^b, P_s^b; F_b).$$

In other words, (W, P_s^H) is the point where the bad type's indifference curve through (P_f^b, P_s^b) intersects the vertical line $P_f = W$.

Provided the equilibrium value of q satisfies

$$\mu(q)U^1(W, P_s^H; F_g) + [1-\mu(q)]U^1(W, P_s^H; F_b) \geq \underline{v}^1, \quad (\text{B.1})$$

the investor will accept (W, P_s^H) in equilibrium, as his expected utility exceeds his reservation utility. Define \bar{q} as the largest value of q such that (B.1) holds. Note, when $q = \bar{q}$, (B.1) is an equality. As we are concentrating on equilibria in which the investor earns no rent, we will only consider the equilibrium in which $q = \bar{q}$.

Proposition 4: *In Case 3, given no restrictions on P_f , the unique equilibrium consists of the bad type offering (W, P_s^H) with probability \bar{q} and (P_f^b, P_s^b) with probability $1 - \bar{q}$, and the good type offering (W, P_s^H) .*

Proof: The following is a PBE: the good type offers (W, P_s^H) , the bad type offers (W, P_s^H) with probability \bar{q} , and the bad type offers (P_f^b, P_s^b) with probability $1-\bar{q}$; the investor believes his opponent is the good type with probability $\mu(\bar{q})$, if he is offered (W, P_s^H) and he believes his opponent is the bad type with certainty, if he is offered a contract other than (W, P_s^H) ; finally, given his beliefs, the investor accepts any contract that yields him expected utility of at least \underline{v}^1 . It is clear that all parties are playing optimally given their beliefs and that on the equilibrium path beliefs are consistent with Bayes' Theorem. The PBE also satisfies the Intuitive Criterion: any deviation the bad type likes, the good type also likes, and there is no *feasible* deviation that the good type likes that the bad type does not also like. That this is the unique hybrid equilibrium (in terms of contracts offered) follows from Lemma 1. As (W, P_s^H) lies below $(W, P_s(W))$, our "no rent" condition rules out pooling equilibria. Finally, employing essentially the same arguments used in Proposition 1, we can rule out separating equilibria.

■

Corollary 4: *In Case 3, if there exists a contract on the pooling line such that the good type is indifferent between that contract and (W, P_s^H) , then there are restrictions that will improve efficiency.*

Proof: By assumption, condition (a) of Proposition 2 is met. Condition (b) is also met because, as this is a hybrid equilibrium, the bad type must like (W, P_s^H) and (P_f^b, P_s^b) equally well.

■

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