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Contracting with Reading Costs and Renegotiation Costs

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy

in
Economics

by

James R. Brennan

Committee in charge:

Professor Joel Watson, Chair
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2007

The dissertation of James R. Brennan is approved, and it is acceptable in quality and form for publication on microfilm:

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2007

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ABSTRACT OF THE DISSERTATION

Contracting with Reading Costs and Renegotiation Costs

by

James R. Brennan

Doctor of Philosophy in Economics

University of California, San Diego, 2007

Professor Joel Watson, Chair

In the economy, contract formation and recontracting are costly, and these costs have important implications for contractual outcomes and economic objectives like efficiency. In this dissertation, I characterize systematically how reading costs and renegotiation costs affect contracting behavior, and I describe how third-party enforcement, conducted by institutions such as courts, might ameliorate efficiency problems associated with both types of costly contracting.

Chapter I contains analysis of contracting and costly renegotiation using mechanism-design. The Renegotiation-Proofness Principle (RPP) is formalized: any state-contingent payoff vector that is implementable with renegotiation is also implemented by a mechanism in which renegotiation does not occur in equilibrium. The RPP is *not* valid. However, our more general monotonicity result confirms the RPP's "renegotiation is bad" message, because it shows the set of implementable state-contingent payoffs becomes larger as the costs of renegotiation increase.

In the model of Chapter II, a buyer must incur a reading cost to understand payoffs sellers' contracts promise. An *equilibrium with reading* exists in which the buyer reads offers with positive probability. Further monotonicity results characterize how the equilibrium depends two enforcement features. Increasing the lowest enforceable payoff reduces the equilibrium reading investment and encourages acceptance. And, reducing reading costs increases the buyer's reading

probability, though the total reading investment is kept low. I indicate several existing institutional rules that limit contract payoffs or reduce reading costs. The penalty doctrine restricts private damages not to exceed harm; substantive unconscionability effectively excuses performance for a low payoff; and procedural unconscionability and disclosure regulations reduce reading costs.

In Chapter III, interaction between a seller who offers a standard form contract and a buyer who reads it—under two-sided asymmetric information—reveals reading costs are not incurred in equilibrium. Payoff-based limitations on enforceable contracts therefore play a vital role in agreement, since any accepted contract will not have been read. An example and general discussion relate expected surplus generated in a *no-reading equilibrium* to contract payoff boundaries defined by enforcement.

I

The Renegotiation-Proofness Principle and Costly Renegotiation

I.A Introduction

In a real contractual relationship, the contracting parties may write a contract that directs an external enforcer (the court, for example) on how to interact with them later. However, the parties may not be jointly committed to their initial contract, to the extent that technology and the legal system allow them to renegotiate it before the external enforcer intervenes. For example, the initial contract may specify an externally-enforced outcome that is ex post inefficient in some contingency. If this contingency arose, the parties would then have the incentive to renegotiate the contractually-specified outcome. This “ex post” renegotiation can have important implications for the attainment of the parties’ contractual goals.

On the theoretical side, researchers have studied renegotiation by finding ways of incorporating it into the standard mechanism-design framework, which has become an important tool for studying contract.¹ The typical mechanism-design

¹See [38] for the basic “mechanism design with ex post renegotiation” methodology. The mechanism-design approach is used in applied settings by, among others, [7], [11], [30], [43], [48], [52], [62].

model specifies sets of *states* and *outcomes* as well as the parties' preferences over the outcomes in each state. For contractual settings of *complete but unverifiable information*, the state is interpreted as an event that the contracting parties jointly observe (but the external enforcer does not observe) and the outcome is interpreted as verifiable items that the external enforcer compels. A contract is then a game form (mechanism) that the external enforcer forces the parties to play after they observe the state. To represent ex post renegotiation, theorists commonly embed it into the specification of preferences; that is, they define payoffs in terms of what renegotiation would yield.

In the mechanism-design literature, the effect of renegotiation on contracting is represented by the Renegotiation-Proofness Principle (RPP), which states that any state-contingent outcome that can be implemented in an environment with renegotiation can also be implemented by a mechanism in which renegotiation does not occur in equilibrium. The RPP plays two roles in the literature. First, it helps simplify the analysis of implementation by allowing theorists to focus on so-called “renegotiation-proof” mechanisms. Second, the RPP captures the idea that the opportunity for parties to renegotiate imposes a constraint on the set of implementable state-contingent outcomes. In other words, the RPP conveys the message that renegotiation is bad for contracting. Unfortunately, the RPP is an ambiguous “result.” It is applied in various modeling exercises, but it has not been stated or validated in a general form.² Further, it is usually invoked without any formal modeling of renegotiation.

In this paper, we clarify the Renegotiation-Proofness Principle by explicitly modeling renegotiation in settings of complete but unverifiable information. We study general renegotiation costs, which includes the cases of free renegotiation and barred renegotiation (the two cases commonly studied in the literature) and everything between. In particular, we are motivated by the observation that, in reality, renegotiation can be moderately costly. For example, to alter a contract,

² [27] and [16] utilize the RPP in models with incomplete information. [47] provides a model in which the RPP fails.

parties may require the services of an attorney who charges them a fee.

Our modeling exercise has three components. First, we develop a method of incorporating costly renegotiation into the mechanism-design framework. In our model, renegotiation activity is defined as a component of the “outcome.” That renegotiation cannot be controlled by the external enforcer is represented as a constraint on the outcomes that may be specified in a mechanism. In other words, renegotiation activity and its costs are designated in the fundamentals of the mechanism-design program, so that noncontractibility of renegotiation translates into a *constraint on the class of mechanisms*.³

Our formulation reveals that commonly-heard statements about “whether a mechanism can replicate what the players could achieve by renegotiating” lack meaning. When renegotiation is properly incorporated into the mechanism-design framework, it is trivially true that a mechanism can replicate renegotiation; this is because renegotiation activity is specified in the outcome. Rather, the important issue is whether the effects of renegotiation can be achieved using some other available technology. For example, suppose the contracting parties would throw away resources in the renegotiation process. Then one must ask whether they could arrange to throw away the same resources without renegotiating, perhaps by an externally-enforced penalty.

Second, we provide a formal statement of the Renegotiation-Proofness Principle and we develop the conditions under which it holds. In essence the RPP involves a comparison between the renegotiation technology and other technologies. Most importantly, we show that the RPP is generally *invalid* in settings of moderate renegotiation costs. That is, in many settings, implementation necessarily involves renegotiation in equilibrium. We show that the RPP does hold when renegotiation is free, which is the common case that theorists have studied but is not necessarily the most realistic case. These results highlight the “free-renegotiation” intuition

³In a related paper, [62] explains why models of mechanism design with ex post renegotiation are invalid if they do not explicitly account for the technology of trade. The points we make here are tangential to Watson’s critique. While we do not explicitly model productive decisions, our model is consistent with Watson’s methodology.

that underlies the literature’s current understanding of the RPP.

Third, we prove a general monotonicity result: that higher renegotiation costs imply a larger set of implementable state-contingent payoffs. This result elucidates the “renegotiation is bad” intuition that lies at the heart of the RPP. We thus argue that, although the RPP is not always valid, it does suggest a general and useful result about the effect of renegotiation costs.

Our analysis complements the work of [51], who study the implications of costly contracting and renegotiation and who identify real costs associated with the legal system. Further, it complements the work of [62], who demonstrates the importance of explicitly modeling the technology of trade in a mechanism-design framework, and the work of [10], who take a similar line in the analysis of evidence disclosure.

The rest of this paper provides the details of our modeling exercise. Section I.B describes the contractual setting and develops our method of incorporating ex post renegotiation into a mechanism-design model. Section I.C states the Renegotiation-Proofness Principle and characterizes the conditions under which it is valid. Section I.D presents our monotonicity result. Section I.E contains a novel example that illustrates the failure of the RPP and shows that, to align investment-incentives, inefficient values may be required in some states.

I.B The Contract Environment

We analyze a class of contractual relationships with external enforcement and complete, but unverifiable, information. Two players interact over four phases of time, as follows. In Phase 1, the players write a contract. The contract directs an external enforcer (a court, for example) on how to intervene in the fourth phase, as a function of verifiable information.

In Phase 2, the *state of the relationship* is realized and is commonly observed by the players. The state may be determined by actions that the players

take and/or it may be influenced by random events; we do not model how the state is determined. The state is not verifiable to the external enforcer. The set of possible states is denoted Θ .

In Phase 3, the players make decisions that are verifiable but are not payoff relevant. For example, the parties may send messages to the external enforcer; the messages have no direct effect on the players' payoffs.

In Phase 4, productive decisions and external enforcement occur. Interaction in this third phase defines the *physical outcome*, which is denoted d . Let D be the set of feasible physical outcomes; we assume D is independent of the realized state. Fourth-phase interaction is constrained by technology and the institutional environment, as discussed later in this section.

The player's payoffs from contractual interaction are defined by the function $u : D \times \Theta \rightarrow \mathbf{R}^2$. We write $u(d|\theta)$ as the payoff vector of physical outcome d in state $\theta \in \Theta$. In forming their contract in the first phase, the players' goal is to *implement* a particular physical outcome—and thus a payoff vector—as a function of the state.

In much of our analysis, it will be convenient to work with physical outcomes in terms of their implied state-contingent payoffs. That is, instead of dealing with d directly, we deal with the function $u(d|\cdot)$, which gives the payoff vector from d as a function of the state. Thus, we use the term *payoff outcome* (*outcome*, for short) for any mapping from the set of states to the set of payoff vectors. Let W be the set of payoff outcomes associated with the set of physical outcomes:

$$W \equiv \{w : \Theta \rightarrow \mathbf{R}^2 \mid \text{there exists } d \in D \\ \text{such that } w(\theta) = u(d|\theta) \text{ for all } \theta \in \Theta\}.$$

I.B.1 Standard Mechanism Design Analysis

To this point, our description of contractual relationships has not indicated the precise structure of interaction in the third and fourth phases. A fully-specified model of any particular contractual relationship requires a more detailed

account. In the standard mechanism-design approach to studying contract, theorists simplify the analysis by making (sometimes implicitly) three assumptions. First, theorists assume that all of the payoff relevant aspects of D are either directly verifiable to the external enforcer or are directly controlled by the external enforcer. Second, whenever they assume that an aspect of D is not directly controlled by the external enforcer, theorists assume that the external enforcer can compel fines or transfers that can be used to levy arbitrarily harsh punishments on individual players. For example, it is common in the literature to assume that, in Phase 4, the parties make verifiable decisions about (a) whether to trade an intermediate good and (b) a monetary transfer from one party to the other. After these decisions, the external enforcer can compel transfers or fines.⁴

These two assumptions motivate theorists to treat d as a "public decision"—that is, made by the external enforcer. In other words, the players' verifiable actions are modeled, for all intents and purposes, as *alienable* (taken out of the players' hands). This assumption is commonly justified by noting that "forcing contracts" can be used to compel the players to take any particular verifiable action as a function of other verifiable events, such as messages sent to the external enforcer in the Phase 3.

The third assumption theorists usually make is that the technology of interaction in Phase 3 is unrestricted. To be more precise, it is assumed that players have the opportunity to send and receive messages sequentially and simultaneously. It will be enough to assume that, in Phase 3, the players simultaneously and independently send messages to the external enforcer. Let $M \equiv M_1 \times M_2$ be the set of possible message profiles.

These assumptions justify treating the players' Phase 1 contracting problem as a standard mechanism-design problem, with fundamentals $\langle \Theta, D, u \rangle$. The contract formed by the players in Phase 1 specifies a *game form* (M, g) , which is defined by a message space M and an externally enforced mapping $g : M \rightarrow D$.

⁴In the literature, the specific mechanics of trade and enforcement are usually not explicitly studied. See [62] regarding the appropriate modeling of trade and enforcement.

The game form can be equivalently written in terms of payoff outcomes, as (M, f) , where $f : M \rightarrow W$ is defined by $f(m) \equiv u(g(m)|\cdot)$ for every $m \in M$. Then, for every state θ , the game form defines an *induced game* $\langle M, f(\cdot)(\theta) \rangle$ that is played in Phase 3. The game form is called a *mechanism*. Note that we focus on static mechanisms.

Behavior in the Phase 3 is modeled by Nash equilibrium, so the players' contracting problem is one of "Nash implementation" [37]. A mechanism, along with a selection of equilibrium in each state, implies a *state-contingent value function* $v : \Theta \rightarrow \mathbf{R}^2$ that gives the resulting payoff vector as a function of the state.⁵ The revelation principle [22]; [41] justifies constraining attention to (a) *direct revelation mechanisms*, where players send reports of the state (so $M \equiv \Theta^2$), and (b) truthful reporting equilibrium, where each player honestly reports the state.

For a direct revelation mechanism (Θ^2, f) , we write $f(\theta_1, \theta_2) = w^{\theta_1\theta_2}$ for the payoff outcome of the message game when player 1 sends message θ_1 and player 2 reports θ_2 . Thus, when the players send reports θ_1 and θ_2 in state θ , the payoff is $w^{\theta_1\theta_2}(\theta)$. Whether truthful reporting is a Nash equilibrium in every state is captured by:

Definition I.1: A mechanism (Θ^2, f) is **incentive-compatible** if, for each $\theta \in \Theta$ and all $\theta'_1, \theta'_2 \in \Theta$, $w_1^{\theta\theta}(\theta) \geq w_1^{\theta'_1\theta}(\theta)$ and $w_2^{\theta\theta}(\theta) \geq w_2^{\theta\theta'_2}(\theta)$.

Implementation of a state-contingent value function is defined by:

Definition I.2: A mechanism (Θ^2, f) **implements** value function v if it is incentive-compatible and $v(\theta) = w^{\theta\theta}(\theta)$ for all $\theta \in \Theta$.

Furthermore, we say that a value function v is *implementable* if a mechanism exists that implements it. We let V denote the set of all implementable value functions.⁶

⁵Where there are multiple equilibria in an induced game, the players' contract specifies which equilibrium they will play. [29] discusses the issue of multiple equilibria and describes several general definitions of implementability.

⁶The set V is well-defined in any contractual environment, because any mechanism that prescribes a constant physical outcome, regardless of messages, will trivially implement some value function.

That is:

$$V \equiv \{v : \Theta \rightarrow \mathbf{R}^2 \mid \text{there is a mechanism } (\Theta^2, f) \text{ that implements } v\}.$$

I.B.2 The Standard Model of Mechanism Design with Ex Post Renegotiation

A key ingredient of the standard mechanism-design model is that the parties are committed to their chosen mechanism, and thus to the public decision their messages prescribe. However, most real enforcement institutions do not allow such commitment. For example, it is not technologically feasible for a public court to administer an arbitrarily chosen mechanism.⁷ In addition, public courts do not enforce contracts verbatim, so, even if full enforcement of mechanisms were possible, institutional constraints limit the contracts that parties can choose.

Recognizing the real commitment problem, theorists have been led to study renegotiation of contracts. The following story illustrates the possibility of “ex post renegotiation.”⁸ Suppose the players agree to a mechanism (Θ^2, g) in Phase 1; the state θ is realized in Phase 2; and, in Phase 3, the parties send reports of the state, θ_1 and θ_2 . Then, just after the reports are sent and assuming that the players each know the other’s report, the players realize that the external enforcer is poised to make the public decision $d = g(\theta_1, \theta_2)$ in Phase 4. However, if d is *inefficient* in the realized state—that is, there is another public decision d' such that $u(d'|\theta) > u(d|\theta)$ (in the vector sense⁹)—then the players have an incentive to alter what their mechanism prescribes, instructing the external enforcer to make a different public decision than d . That is, the players can substitute some d' for $g(\theta_1, \theta_2)$ just before the external enforcer makes the public decision. If the players can renegotiate in this way, then they cannot commit to their original mechanism; instead, the original mechanism sets the default point for possible renegotiation

⁷See [62] regarding the appropriate theoretical approach to modeling trade technology and external enforcement.

⁸Papers in the “mechanism design with ex post renegotiation” literature include [38] and [52].

⁹Note that “ $>$ ” means weakly greater for both coordinates and strictly greater for at least one coordinate.

contingent on the state.¹⁰

To model ex post renegotiation, theorists have used the following clever trick (following [38]). They specify a “renegotiation function” $h : D \times \Theta \rightarrow D$, which gives the renegotiated public decision d' as a function of the actual state θ and the decision d that the original mechanism prescribes. That is, $d' = h(d|\theta)$. Assuming that the players rationally anticipate renegotiation, this changes the induced game that they play in Phase 3. Rather than the message profile (θ_1, θ_2) yielding the payoff vector

$$u(g(\theta_1, \theta_2)|\theta)$$

in state θ , as would be the case without renegotiation, this message profile instead yields the payoff

$$u(h(g(\theta_1, \theta_2)|\theta)|\theta).$$

Accordingly, one can redefine the utility function to incorporate the renegotiation activity h . For every state θ and every public decision d , define

$$\hat{u}(d|\theta) \equiv u(h(d|\theta)|\theta).$$

Then, a setting of mechanism design with ex post renegotiation, given by $\langle \Theta, D, u, h \rangle$, is equivalent to the standard mechanism-design problem defined by $\langle \Theta, D, \hat{u} \rangle$.

I.B.3 A More General Approach

The analytical method described in the previous subsection is shorthand for explicitly modeling renegotiation activity. Although it has been useful in the literature, this shorthand method is not well-suited for studying settings in which renegotiation entails a cost. For example, suppose renegotiation requires payments to an attorney. To study this setting using the literature’s trick, one would have to define utility function \hat{u} to embody these payments. However, then we have a payoff-relevant aspect of strategic interaction (transfers made to a third party)

¹⁰When trade decisions are explicitly modeled, it is more appropriate to call this “interim renegotiation;” see [62]. There may also be “ex ante renegotiation”—occurring before players send messages—which we discuss in the Conclusion but do not study here.

that is not specified in the fundamentals of the mechanism-design problem. To some extent, this contradicts the mechanism-design ideal—that all payoff-relevant aspects of interaction are included in the “outcome.” As a result, we cannot represent formally, for example, whether the external enforcer can take an action that achieves the same payoffs that could be reached with renegotiation. This is critical because we need to compare, in payoff terms, the renegotiation technology with other technologies. Note as well that the renegotiation activity cannot be put in terms of the literature’s “ h ” function without including its payoff-relevant aspects in the definition of the “outcome.” Thus, it is not obvious even how to define whether renegotiation occurs.

The proper way of analyzing renegotiation while continuing to adhere to the mechanism-design framework is to represent renegotiation activity in the fundamentals of a mechanism-design problem and to represent noncontractibility of renegotiation behavior as a constraint on mechanism design. For example, we could define the “outcome” to include, in addition to those things that the external enforcer can compel, any payments made to an attorney. The contracted game form would then describe (a) how the players are to send messages and (b) the manner in which the players will renegotiate. To capture the idea that the opportunity to renegotiate is noncontractible, we should restrict attention to game forms that contain a fixed “ex post” renegotiation phase, whereby the outcome is a particular function of the renegotiation behavior. With this theoretical foundation, it is trivially true that “a mechanism can replicate renegotiation,” because renegotiation is defined as a component of the mechanism.

Rather than modeling renegotiation as a component of the game form, we follow the lead of [62] and develop a variation of this modeling approach in which the renegotiation activity is a component of the outcome. That renegotiation activity is noncontractible will imply a constraint on the set of outcomes that can be specified in a mechanism. This approach lends itself more easily to standard mechanism-design analysis (as does the literature’s current trick for the costless

renegotiation setting) than does the tack described in the preceding paragraph.

To represent the renegotiation opportunity, we suppose that interaction in Phase 4 of the contractual relationship can be divided into two sub-phases, the resolution of which are given by x and y . The variable x represents what the external enforcer can compel; that is, the external authority either directly controls x , or at least x is verifiable and can be compelled by the threat of external punishment. From this point on, we call x the *public decision*. Think of the public decision as representing trade and transfers. Let X be the set of possible public decisions.

The variable y represents the players' renegotiation activity.¹¹ It is non-contractible, due to either technological or institutional limitations, and, therefore, the external enforcer does not control y . Let Y be the set of all possible renegotiation activity. An element of Y , for instance, may be "Each player pays \$200 to an attorney, who modifies their contract so that 'trade nothing' is put in place of 'trade 68 bushels of wheat at \$15 per bushel.'" Since the players know the state when they renegotiate, y is conditioned on θ . We let the function $\gamma : \Theta \rightarrow Y$ represent the renegotiation activity as a function of the state, and we let Γ be the set of all such functions.

We next add structure to the x and y components of interaction in Phase 4. Specifically, we assume that there is a *default public decision* \underline{x} that the players know will be chosen by the external enforcer if they fail to renegotiate it. Furthermore, we summarize the (perhaps complicated) renegotiation activity in terms of (a) the renegotiated public decision and (b) transfers and expenditures made by the players during the renegotiation process. Thus, we define $Y \equiv X \times \mathbf{R}_-^2$, where

$$\mathbf{R}_-^2 \equiv \{(t_1, t_2) \in \mathbf{R}^2 \mid t_1 + t_2 \leq 0\}.$$

Here, t_i is the transfer to player i . We assume that the total transfer is nonpositive;

¹¹One can think of y as a strategy profile in some non-cooperative renegotiation game that is played after messages are sent. We use a simpler "cooperative game theory" representation.

if it is negative then this is the players' joint renegotiation expenditure. We write $y = (x, t)$. Also, given a state-contingent schedule of renegotiation activity γ , we write $\gamma(\theta) = (\gamma_x(\theta), \gamma_t(\theta))$, where $\gamma_x : \Theta \rightarrow X$ and $\gamma_t : \Theta \rightarrow \mathbf{R}_-$.

We use the term *minimal renegotiation activity* to mean that the default public decision is not renegotiated. Specifically, if \underline{x} is the default public decision, then minimal renegotiation activity is $y = (\underline{x}, \underline{t})$, where $\underline{t} \equiv (0, 0)$. This concept will be important for stating the Renegotiation-Proofness Principle in Section 3.

The physical outcome in Phase 4 is defined by a default public decision \underline{x} and a specification of renegotiation activity γ . Thus, we have $D \equiv X \times \Gamma$. We assume that payoffs are additive in renegotiation expenditures. That is, there is a function $\tilde{u} : X \times \Theta \rightarrow \mathbf{R}^2$ such that, in every state $\theta \in \Theta$ and for each outcome $d = (\underline{x}, \gamma)$, the payoff vector is

$$u(d|\theta) \equiv \tilde{u}(\gamma_x(\theta)|\theta) + \gamma_t(\theta).$$

Thus, the players' payoffs depend only on the state, the public decision, and any transfers and expenditures made during renegotiation.

We make the following assumption jointly on the set of public decisions and the payoff function:

Assumption I.1 (Comprehensiveness): *Take any state $\theta \in \Theta$, any default public decision $\underline{x} \in X$, and any renegotiation activity $(x, t) \in Y$ such that $\tilde{u}(x|\theta) + t \geq \tilde{u}(\underline{x}|\theta)$. Then there exists a public decision $\underline{x}' \in X$ such that $\tilde{u}(\underline{x}'|\theta) = \tilde{u}(x|\theta) + t$.*

This assumption means that, for every state, any payoff vector that can be achieved through renegotiation can also be achieved with minimal renegotiation activity (with a suitably chosen default public decision). This is assumed for every payoff vector that weakly exceeds (in the vector sense) the payoff from some arbitrary public decision.¹²

¹²It may be natural to require that any default public decision may be renegotiated to any other public decision, for a sufficient renegotiation expenditure. Though intuitively appealing, this is not necessary for our analysis.

As an example, suppose the default public decision \underline{x} is “trade 50 units of the intermediate good at \$20 per unit” and the decision x^* is “trade 62 units of the intermediate good at \$19 per unit.” Further suppose that x^* is an efficient public decision in state θ , meaning that x^* maximizes $\tilde{u}_1(x|\theta) + \tilde{u}_2(x|\theta)$ by choice of x . Let $\tilde{u}(\underline{x}|\theta) = (240, 350)$ and $\tilde{u}(x^*|\theta) = (300, 410)$. Imagine that \underline{x} is specified as the default public decision. In state θ , the players may renegotiate to select x^* , with each player making an expenditure of 30, yielding the payoff vector $(270, 380)$. The expenditures may be money paid to an attorney whose services are required to alter a contract. Comprehensiveness requires the existence of another public decision \underline{x}' such that $\tilde{u}(\underline{x}'|\theta) = (270, 380)$, a payoff which then could be achieved with minimal renegotiation activity $(\underline{x}', \underline{t})$. For instance, \underline{x}' might be “trade 62 units of the intermediate good at \$19 per unit and each donate 30 to charity.” As this example demonstrates, comprehensiveness relies on a fairly broad range of contractible items; the assumption is essential for the Renegotiation-Proofness Principle.

Standard mechanism-design analysis can be employed for the setting $\langle \Theta, D, u \rangle$, except that there are now constraints on γ . These constraints fall into two categories. First, there may be institutional constraints. We represent these as feasibility restrictions on the renegotiation activity, as a function of the state. Specifically, in state θ and with default public decision \underline{x} , the players’ renegotiation activity is restricted to some set $\hat{Y}(\underline{x}|\theta) \subset Y$. We are especially interested in how \hat{Y} represents restrictions that are due to intrinsic costs of renegotiation—time spent bargaining and modifying the contract, payments made to attorneys, and so on. For example, renegotiating the default decision “sell 600 bushels of wheat at \$10 per bushel” to another public decision “sell 500 bushels at \$11 each” may require a nonnegligible expenditure.

The second constraint on γ is behavioral: γ must be consistent with an appropriate theory of bargaining behavior. In other words, the selection of an element in \hat{Y} depends on one’s theory of negotiation. At this point, we will

not adopt any particular bargaining theory. However, we do assume that the bargaining theory identifies a single element of $\hat{Y}(\underline{x}|\theta)$ for every state θ and every default public decision \underline{x} . We let $y^*(\underline{x}|\theta)$ denote the prediction of the bargaining theory in state θ , given default public decision \underline{x} .

Our analysis hereinafter takes $y^*(\cdot|\cdot)$ as fundamental. That is, we suppose there is a function $y^* : X \times \Theta \rightarrow Y$ that gives the renegotiation activity as a function of the default public decision and the state. This function implicitly represents the constraints of \hat{Y} as well as the theory of negotiation. We call y^* the *renegotiation function*. Where we need to separate the x and t components of y , we write $y^*(\underline{x}|\theta) \equiv (y_x^*(\underline{x}|\theta), y_t^*(\underline{x}|\theta))$. Also, with regard to a specific default decision \underline{x} and a state θ , we speak of $\tilde{u}(\underline{x}|\theta)$ as the *disagreement payoff* and we call

$$\tilde{u}(y_x^*(\underline{x}|\theta)|\theta) + y_t^*(\underline{x}|\theta)$$

the *renegotiated payoff*.

The institutional and behavioral restrictions imply that the physical outcome in Phase 4 must be an element of the subset of D given by

$$D^* \equiv \{(\underline{x}, \gamma) \in D \mid \gamma(\theta) = y^*(\underline{x}|\theta) \text{ for every } \theta \in \Theta\}.$$

The set D^* gives precisely the set of contractible physical outcomes for the setting of mechanism design with ex post renegotiation. Thus, a setting of mechanism design with ex post renegotiation, given by $\langle \Theta, D, u, y^* \rangle$, is equivalent to the standard mechanism-design problem defined by $\langle \Theta, D^*, u \rangle$. In words, because some aspects of interaction in Phase 4 are not controlled by the external enforcer, implementation is constrained by the theory of how these aspects are resolved. The physical outcomes that are consistent with the renegotiation theory are simply a subset of the set of all possible physical outcomes.

I.B.4 Assumptions on the Renegotiation Function

We make five straightforward assumptions on the renegotiation function y^* . We start by assuming that, whenever the renegotiated payoff equals the payoff

vector that the players would have gotten with minimal renegotiation, then the function specifies minimal renegotiation.

Assumption I.2: *For every $\theta \in \Theta$ and every $\underline{x} \in X$, if $\tilde{u}(y_x^*(\underline{x}|\theta)|\theta) + y_t^*(\underline{x}|\theta) = \tilde{u}(\underline{x}|\theta)$ then it is the case that $y^*(\underline{x}|\theta) = (\underline{x}, \underline{t})$.*

This assumption clarifies “minimal renegotiation activity;” players do not engage in non-minimal renegotiation unless it is to alter payoffs.

Next, we assume that the renegotiation function y^* implies a functional relation between the disagreement payoff and the renegotiated payoff in any state.

Assumption I.3: *Fix any state θ . If $\tilde{u}(\underline{x}|\theta) = \tilde{u}(\underline{x}'|\theta)$, then*

$$\tilde{u}(y_x^*(\underline{x}|\theta)|\theta) + y_t^*(\underline{x}|\theta) = \tilde{u}(y_x^*(\underline{x}'|\theta)|\theta) + y_t^*(\underline{x}'|\theta).$$

We next define a function H to represent this relation. Let

$$Q(\theta) \equiv \{z \in \mathbf{R}^2 \mid \text{there exists } \underline{x} \in X \text{ with } z = \tilde{u}(\underline{x}|\theta)\},$$

which is the set of possible disagreement payoffs in state θ . For every $z \in Q(\theta)$, let

$$H(z|\theta) \equiv \tilde{u}(y_x^*(\underline{x}^z|\theta)|\theta) + y_t^*(\underline{x}^z|\theta),$$

where \underline{x}^z is such that $\tilde{u}(\underline{x}^z|\theta) = z$. Thus, if z is the disagreement payoff in state θ then $H(z|\theta)$ is the renegotiated payoff.¹³

The rest of our assumptions are stated using the function H .

Assumption I.4 (Individual Rationality): *In every state $\theta \in \Theta$ and for every disagreement payoff $z \in Q(\theta)$, it is the case that $H(z|\theta) \geq z$ (in the vector sense).*

Assumption I.4 is the standard assumption that the players would not accept less than they could get by refusing to renegotiate.

¹³Assumption I.3 simplifies the analysis, but versions of our results would hold if we relaxed this assumption.

Assumption I.5 (Continuity): For every state θ , $H(\cdot|\theta)$ is continuous (in z).

Our final assumption is monotonicity of the renegotiated payoff with respect to the disagreement payoff.

Assumption I.6 (Monotonicity): Fix any state $\theta \in \Theta$ and any two disagreement payoff vectors $z, z' \in Q(\theta)$. For any $i = 1, 2$ and $j \neq i$, if $z_i \geq z'_i$ and $z_j = z'_j$, then $H_j(z|\theta) \leq H_j(z'|\theta)$.

In words, Assumption 4 states that, if the disagreement payoff shifts in player i 's favor, then player j 's renegotiated payoff weakly decreases. See [60] for a discussion of this type of assumption in bargaining theory.

I.B.5 A Class of Costly Renegotiation Functions

In this subsection, we describe a parameterized class of renegotiation functions to represent the idea that the players cannot extract all of the potential surplus from changing the contractually-specified public decision. For example, suppose that public decision \underline{x} is about to be enforced in state θ . If there is another public decision $x \in X$ for which

$$\tilde{u}_1(x|\theta) + \tilde{u}_2(x|\theta) > \tilde{u}_1(\underline{x}|\theta) + \tilde{u}_2(\underline{x}|\theta),$$

then the players would like to renegotiate the default public decision. However, this may require an expenditure. We suppose that the players must jointly pay α in order to re-specify the public decision. Further, they must pay a fraction β of the surplus created by changing the public decision. A transfer between the players is unrestricted. The costs impose constraints on the feasible renegotiation activity which are given by:

$$\hat{Y}(\underline{x}|\theta; \alpha, \beta) = \left\{ (x, t) \left| t_1 + t_2 \leq -\beta \left[\sum_{i=1,2} (\tilde{u}_i(x|\theta) - \tilde{u}_i(\underline{x}|\theta)) \right] - \alpha I_{X \setminus \{\underline{x}\}} \right. \right\}. \quad (\text{I.1})$$

Here, $I_{X \setminus \{\underline{x}\}}$ is the indicator function that equals 0 when $x = \underline{x}$ and equals 1 otherwise.

Facing \hat{Y} in state θ and with default public decision \underline{x} , the players' available renegotiation surplus is

$$r(\underline{x}|\theta) = \max_{(x,t) \in \hat{Y}(\underline{x}|\theta;\alpha,\beta)} \sum_{i=1}^2 [\tilde{u}_i(x|\theta) + t_i - \tilde{u}_i(\underline{x}|\theta)]. \quad (\text{I.2})$$

We suppose that the players choose x to achieve this surplus and that they select transfers to split the surplus according to fixed bargaining weights π_1 and π_2 , where $\pi_1, \pi_2 \geq 0$ and $\pi_1 + \pi_2 = 1$. That is, $y^*(\underline{x}|\theta)$ solves (I.2) and gives player i the payoff $\tilde{u}_i(\underline{x}|\theta) + \pi_i r(\underline{x}|\theta)$. The assumptions stated in the previous subsection all hold.

The renegotiation theory embodied in Equations I.1 and I.2 is quite flexible. For example, we obtain the standard “free-renegotiation” case (equivalent to the setting described in Subsection I.B.2) by specifying $\alpha = \beta = 0$. We also use the term “costless renegotiation” to describe this case. If $\beta = 0$ but $\alpha > 0$, so that

$$\hat{Y}(\underline{x}|\theta; \alpha, 0) = \{(x, t) \in Y \mid x = \underline{x} \text{ or } t_1 + t_2 \leq -\alpha\},$$

then we have the case in which the players only must pay a lump sum α to make any change in the specified public decision. In the extreme, we could have $\alpha = \infty$, which means renegotiation is not possible. Finally, when $\alpha = 0$ but $\beta > 0$, then there are only proportional costs of renegotiation activity. In this case, the players renegotiate to the ex post efficient public decision, but they lose some fraction of the surplus to transaction costs.

In practical terms, α and β may represent transaction costs that are inherent in the process of negotiation or expenditures that must be paid to third parties. As an illustration, consider the example that follows the comprehensiveness assumption in Subsection I.B.4. The default public decision \underline{x} is “trade 50 units of the intermediate good at \$20 per unit;” the public decision x^* is “trade 62 units of the intermediate good at \$19 per unit.” In state θ , $\tilde{u}(\underline{x}|\theta) = (240, 350)$, whereas $\tilde{u}(x^*|\theta) = (300, 410)$. Suppose that, to change their contractually-specified public decision, the players must obtain the services of an attorney who (because of

his bargaining power) extracts 50 percent of the gain. If the default public decision is \underline{x} , then the players would renegotiate to select x^* and, subtracting the attorney's share, they obtain the payoff vector (270, 380). Further, consider the public decision \underline{x}' : "trade 62 units of the intermediate good at \$19 per unit and each donate 30 to charity." If \underline{x}' were specified as the default public decision, then renegotiation would entail selection of x^* with attorney's fees of 15 for each player. In other words, the attorney helps strike the "charity" line from the players contract, at a fee of 15 per player.

I.C The Renegotiation-Proofness Principle

In this section, we use the concept of minimal renegotiation to formally evaluate the Renegotiation-Proofness Principle. Our definitions are written in terms of payoff outcomes. Recall that an arbitrary mechanism-design problem with renegotiation function y^* , $\langle \Theta, D, u, y^* \rangle$, is equivalent to an unconstrained mechanism-design problem $\langle \Theta, D^*, u \rangle$, where D^* is a subset of D . Incorporating the D^* constraint, the set of payoff outcomes is:

$$W \equiv \{w : \Theta \rightarrow \mathbf{R}^2 \mid \text{there exists } \underline{x} \in X \text{ such that} \\ w(\theta) = H(\tilde{u}(\underline{x}|\theta)|\theta) \text{ for all } \theta \in \Theta\}.$$

We let \hat{W}^θ be the set of payoff outcomes that have minimal renegotiation activity in state θ :

$$\hat{W}^\theta \equiv \{w : \Theta \rightarrow \mathbf{R}^2 \mid \text{there exists } \underline{x} \in X \text{ such that} \\ w(\theta') = H(\tilde{u}(\underline{x}|\theta')|\theta') \text{ for all } \theta' \in \Theta, \\ \text{and } w(\theta) = \tilde{u}(\underline{x}|\theta)\}.$$

Note that, in the definition of \hat{W}^θ , $H(\tilde{u}(\underline{x}|\theta)|\theta) = \tilde{u}(\underline{x}|\theta)$ means that $y^*(\underline{x}|\theta) = (\underline{x}, \underline{t})$.

The following is our formal definition of "renegotiation-proof." Recall

that, for any mechanism (Θ^2, f) , we let $w^{\theta_1\theta_2} = f(\theta_1, \theta_2)$ denote the payoff outcome when the players send reports θ_1 and θ_2 .

Definition I.3: *We say that a mechanism (Θ^2, f) does not necessitate renegotiation if $w^{\theta\theta} \in \hat{W}^\theta$ for every $\theta \in \Theta$.*

A mechanism necessitates renegotiation if there is a state θ in which truthful reports lead to a payoff outcome that requires non-minimal renegotiation activity in state θ .

Recall that V denotes the set of implementable value functions. Let V^{NR} be the set value functions that are implemented by mechanisms that do not necessitate renegotiation. We express the Renegotiation-Proofness Principle in terms of V and V^{NR} .

Definition I.4: *The Renegotiation-Proofness Principle (RPP) is said to be valid if $V = V^{\text{NR}}$.*

Our first theorem characterizes the conditions under which the RPP is valid.¹⁴ Note that comprehensiveness and individual rationality (Assumptions I.1 and I.4) imply that, for every $\theta \in \Theta$, $H(Q(\theta)|\theta) \subset Q(\theta)$.

Definition I.5: *We say that Sobel's Condition is satisfied if, for every $\theta \in \Theta$ and every $z \in Q(\theta)$, $H(H(z|\theta)|\theta) = H(z|\theta)$.*

This condition has a simple interpretation.¹⁵ Consider any state θ . From a given disagreement payoff z , renegotiation would lead to the payoff $z' = H(z|\theta)$. We know, from the comprehensiveness assumption, that there is a public decision $\underline{x}' \in X$ such that $z' = \tilde{u}(\underline{x}'|\theta)$. When Sobel's condition is satisfied, the default public decision \underline{x}' would not be renegotiated in state θ . The condition is essential to the RPP because, if payoff outcome z' were desired in state θ , it could be achieved with minimal renegotiation activity.

¹⁴This notion of renegotiation-proofness requires only that minimal renegotiation activity follow truthful reports. One can imagine a stronger version of renegotiation-proofness that extends this requirement to out-of-equilibrium contingencies. [48], for example, work with a stronger version.

¹⁵We thank Joel Sobel for suggesting that we formulate the condition in this way.

Theorem I.1: *The Renegotiation-Proofness Principle is valid if and only if Sobel's Condition is satisfied.*

To prove Theorem I.1, we use the following result.

Lemma I.1: *If Sobel's Condition is satisfied then, for every $w \in W$ and every $\theta \in \Theta$, there is a payoff outcome $\hat{w}^\theta \in \hat{W}^\theta$ such that $\hat{w}^\theta(\theta) = w(\theta)$.*

Proof: That $w \in W$ implies the existence of some $\underline{x} \in X$ such that $w(\theta) = H(\tilde{u}(\underline{x}|\theta)|\theta)$. Comprehensiveness implies the existence of some $\underline{x}' \in X$ such that $\tilde{u}(\underline{x}'|\theta) = w(\theta) \equiv z'$. Sobel's condition then implies that $H(z'|\theta) = z'$. From Assumption I.2, we know that $y^*(\underline{x}'|\theta) = (\underline{x}', \underline{t})$. Define payoff outcome \hat{w}^θ by

$$\hat{w}^\theta(\theta') \equiv H(\tilde{u}(\underline{x}'|\theta')|\theta')$$

for every $\theta' \in \Theta$. Clearly, $\hat{w}^\theta(\theta) = w(\theta)$ and $\hat{w}^\theta \in \hat{W}^\theta$. *Q.E.D.*

Proof of Theorem I.1: First we prove that Sobel's condition implies $V = V^{\text{NR}}$. Clearly, $V^{\text{NR}} \subset V$. Take any $v \in V$. We must show that $v \in V^{\text{NR}}$. Let (Θ^2, f) be a mechanism that implements v and define $w^{\theta_1\theta_2} \equiv f(\theta_1, \theta_2)$ for all $\theta_1, \theta_2 \in \Theta$. For each $\theta \in \Theta$, Lemma I.1 implies the existence of $\hat{w}^\theta \in \hat{W}^\theta$ such that $\hat{w}^\theta(\theta) = w^{\theta\theta}(\theta)$. Define a function $f' : \Theta^2 \rightarrow W$ so that, for every $\theta \in \Theta$, $f'(\theta, \theta) = \hat{w}^\theta(\theta)$ and, for each pair $\theta_1, \theta_2 \in \Theta$ with $\theta_1 \neq \theta_2$, $f'(\theta_1, \theta_2) = f(\theta_1, \theta_2)$. By construction, (Θ^2, f') implements v and does not necessitate renegotiation.

Next we prove that $V = V^{\text{NR}}$ implies Sobel's condition. Presuming that Sobel's Condition is not satisfied, we will find a value function that is an element of V but not an element of V^{NR} . Because Sobel's Condition is not satisfied, there is a state θ and a payoff vector $z \in Q(\theta)$ such that

$$H(H(z|\theta)|\theta) \neq H(z|\theta).$$

Let \underline{x} satisfy $\tilde{u}(\underline{x}|\theta) = z$ and define w^* by

$$w^*(\theta') = H(\tilde{u}(\underline{x}|\theta')|\theta'),$$

for every $\theta' \in \Theta$. Let \underline{x}' satisfy $\tilde{u}(\underline{x}'|\theta) = H(z|\theta)$. We then have $w^*(\theta) = H(z|\theta)$ but $y^*(\underline{x}'|\theta) \neq (\underline{x}', \underline{t})$, so non-minimal renegotiation activity occurs in state θ with default public decision \underline{x}' . (We are justified in focusing on one public decision \underline{x}' because of Assumptions I.2 and I.3.) Define a mechanism by $f(\theta_1, \theta_2) \equiv w^*$ for all $\theta_1, \theta_2 \in \Theta$. This mechanism implements the value function $v^* \equiv w^*$, which is not an element of V^{NR} . *Q.E.D.*

We next provide two corollaries that add to the intuition of Theorem I.1.

Define

$$V^{\text{Eff}} \equiv \{v \in V \mid \text{there is no state } \theta \in \Theta \text{ for which} \\ \tilde{u}(\underline{x}|\theta) > v(\theta) \text{ for some } \underline{x} \in X.\}.$$

Value functions in V^{Eff} yield efficient payoffs in all states.

Corollary I.1: $V^{\text{Eff}} \subset V^{\text{NR}}$.

In words, any value function that specifies an efficient payoff vector in every state can be implemented with minimal renegotiation in every state. This follows from the fact that, if $z \in Q(\theta)$ is efficient in state θ then, by individual rationality (Assumption I.4), $H(z|\theta) = z$. Of course, in many important settings, theorists and practitioners are interested in achieving *inefficient* payoffs in some states. The example we provide in Section I.E, which demonstrates the failure of the RPP, has this flavor.

Our second corollary is useful for discussing the class of renegotiation functions introduced in Subsection I.B.5. We use the following definition.

Definition I.6: *We say that **Condition PR is satisfied** if, for every state $\theta \in \Theta$ there is a set $Z^\theta \subset Q(\theta)$ such that (i) no two elements of Z^θ are Pareto-ranked and (ii) for every $z \in Q(\theta)$, $H(z|\theta) \in Z^\theta \cup \{z\}$.*

By ‘‘Pareto ranked’’ we mean that there are vectors $z, z' \in Z^\theta$ such that $z > z'$.

Corollary I.2: *Condition PR implies Sobel’s Condition and, hence, validity of the Renegotiation-Proofness Principle.*

To understand this corollary, consider any state θ and a vector $z \in Q(\theta)$. Condition PR implies that either $H(z|\theta) = z$ or $H(z|\theta) \in Z^\theta$. In the former case, Sobel's Condition clearly holds at the point z . In the latter case, part (i) of Condition PR and individual rationality (Assumption I.4) imply Sobel's Condition at point z .

Returning to the class of renegotiation functions described in Subsection I.B.5, first consider the special case of $\alpha = \beta = 0$, where renegotiation is frictionless (there are no institutional or technological constraints). In this case, all implementable value functions belong to V^{Eff} , so the RPP is valid. In other words, the RPP is valid in the free-renegotiation setting that is popular in the contract theory literature. This case illustrates the importance of the comprehensiveness assumption, which states that every payoff vector that can be achieved via non-minimal renegotiation can also be reached with minimal renegotiation (by specifying an appropriately chosen public decision).

Next consider the case of $\alpha > 0$ and $\beta = 0$. Here, Condition PR holds and thus the RPP is again valid. To see this, first note that the players only pay a fixed joint expenditure to alter the default public decision in any way. In a given state θ , the players will pay the renegotiation cost if and only if it does not exceed the joint value of changing the public decision. It follows that every default decision yielding a payoff that is sufficiently close to the Pareto frontier will not be renegotiated. In this range, $z = H(z|\theta)$. On the other hand, public decisions that would yield lower payoffs will be renegotiated, leading to payoffs in the set

$$Z^\theta \equiv \left\{ (\phi_1, \phi_2) \mid \phi_1 + \phi_2 = \max_{x \in X} [\tilde{u}_1(x|\theta) + \tilde{u}_2(x|\theta)] - \alpha \right\}.$$

Clearly, Z^θ has no Pareto-ranked points and $H(z|\theta) = z$ for every $z \in Z^\theta$. In the special case of $\alpha = \infty$ (where renegotiation is not possible), we have $z = H(z|\theta)$ for every $z \in Q(\theta)$, and so the RPP trivially holds.

Finally, suppose that $\alpha = 0$ and $\beta > 0$. In this important case, Sobel's Condition fails and so the RPP is not valid. Here is the intuition behind failure of Sobel's Condition. Suppose that a default public decision \underline{x} is specified and that it is inefficient in state θ . Let x^* be an efficient public decision, which maximizes

$\tilde{u}_1(x|\theta) + \tilde{u}_2(x|\theta)$ by choice of x . With the proportional renegotiation cost, the players will renegotiate to select x^* and they will obtain the payoff vector z' given by

$$z'_i = \tilde{u}_i(\underline{x}|\theta) + \pi_i(1 - \beta)[\tilde{u}_i(x^*|\theta) - \tilde{u}_i(\underline{x}|\theta)],$$

for $i = 1, 2$. The comprehensiveness assumption implies the existence of another public decision \underline{x}' satisfying $\tilde{u}(\underline{x}'|\theta) = z'$. If \underline{x}' were specified as the default public decision, the players would renegotiate to select x^* and, factoring in the proportional cost, player i obtains

$$\tilde{u}_i(\underline{x}'|\theta) + \pi_i(1 - \beta)[\tilde{u}_i(x^*|\theta) - \tilde{u}_i(\underline{x}'|\theta)],$$

which exceeds z'_i , for $i = 1, 2$. Thus, a mechanism that yields payoff z' in state θ necessitates renegotiation.

I.D Monotonicity

In this section, we evaluate the RPP's underlying theme that renegotiation opportunities constrain the set of implementable value functions. We show that this insight is more general than is the RPP itself. In particular, in the contracting environments we study, the set of implementable value functions is always increasing in the cost of renegotiation.

To formally state our result, we compare different renegotiation functions on the basis of their implied renegotiation cost. Because the renegotiated payoff depends on the renegotiation function, we now explicitly identify the parameter y^* in the function H .

Definition I.7: *Renegotiation function \hat{y}^* represents higher renegotiation costs than does function y^* if, for every state $\theta \in \Theta$ and every $z \in Q(\theta)$, it is the case that $H(z|\theta; y^*) \geq H(z|\theta; \hat{y}^*)$.*

In words, one renegotiation function is costlier than is another if, in every state and for every public decision, the renegotiated payoff vector is weakly lower under

the costlier renegotiation activity.

To state our main result, we write the set of implementable value functions as $V(y^*)$, which makes explicit the dependence of the implementable set on the renegotiation function.

Theorem I.2: *If \hat{y}^* represents higher renegotiation costs than does y^* , then we must have $V(y^*) \subset V(\hat{y}^*)$.*

That is, any increase in the cost of renegotiation widens the scope of implementability.

To illustrate Theorem I.2, we use the class of renegotiation functions developed in Subsection I.B.5. It is easy to verify that, for this class of renegotiation functions, the renegotiated payoff decreases in the parameters α and β . More formally, suppose y^* is defined by parameters α and β , \hat{y}^* is defined by parameters $\hat{\alpha}$ and $\hat{\beta}$, and $\hat{\alpha} \geq \alpha$ and $\hat{\beta} \geq \beta$. Then \hat{y}^* represents higher renegotiation costs than does y^* and thus $V(y^*) \subset V(\hat{y}^*)$.

We prove Theorem I.2 with the help of two lemmas. Note that we shall now write the set of payoff outcomes as $W(y^*)$, to make explicit its dependence on the renegotiation function.

Lemma I.2: *If \hat{y}^* represents higher renegotiation costs than does y^* then, for every $w \in W(y^*)$, there exists $\hat{w} \in W(\hat{y}^*)$ such that $w(\theta) \geq \hat{w}(\theta)$ for each $\theta \in \Theta$.*

Proof: Define \hat{w} using the same default public decisions that are specified to define w . In each state, every default public decision leads to lower renegotiated payoffs under \hat{y}^* than under y^* , by the definition of “higher renegotiation cost.” *Q.E.D.*

Lemma I.3: *If \hat{y}^* represents higher renegotiation costs than does y^* , then $H(Q(\theta)|\theta; y^*) \subset H(Q(\theta)|\theta; \hat{y}^*)$ for every $\theta \in \Theta$.*

Proof: Fix a state θ and a vector of renegotiated payoffs $z^* \in H(Q(\theta)|\theta; y^*)$, and let the vector of disagreement payoffs $\underline{z} \in Q(\theta)$ satisfy $H(\underline{z}|\theta; y^*) = z^*$. We

will show that there is another disagreement payoff vector $\hat{z} \in Q(\theta)$ such that $H(\hat{z}|\theta; \hat{y}^*) = z^*$. Let

$$S \equiv \{z_1 \in \mathbf{R} \mid \underline{z}_1 \leq z_1 \leq z_1^*\}$$

and let

$$T \equiv \{z_2 \in \mathbf{R} \mid \underline{z}_2 \leq z_2 \leq z_2^*\}.$$

Note that $S \times T \subset Q(\theta)$ by the comprehensiveness assumption. Also define the correspondence $\mu_2 : S \Rightarrow T$ as:

$$\mu_2(z_1) \equiv \{z_2 \in T \mid H_2((z_1, z_2)|\theta; \hat{y}^*) = z_2^*\}.$$

Define $\mu_1 : T \Rightarrow S$ analogously. It is easy to verify that the correspondences μ_1 and μ_2 are well-defined and compact-valued. (Both facts rely on continuity of H and the individual-rationality and monotonicity assumptions.) Next, define $\sigma_1 : T \rightarrow S$ and $\sigma_2 : S \rightarrow T$ by $\sigma_1(z_2) \equiv \max \mu_1(z_2)$ and $\sigma_2(z_1) \equiv \max \mu_2(z_1)$. Both are well-defined given the properties of μ_1 and μ_2 .

Construct a sequence of disagreement payoffs $\{z^k\}$ as follows. First, let $z^1 = (\underline{z}_1, \sigma_2(\underline{z}_1))$ and let $z^2 = (\sigma_1(z_2^1), z_2^1)$. Proceeding inductively, for any odd k , let $z^k = (z_1^{k-1}, \sigma_2(z_1^{k-1}))$ and, for any even k , let $z^k = (\sigma_1(z_2^{k-1}), z_2^{k-1})$. Since $S \times T$ is compact and since $\{z^k\}$ is increasing—that is, the sequences $\{z_1^k\}$ and $\{z_2^k\}$ are each increasing—we know that $\{z^k\}$ converges to some point $\hat{z} \in S \times T$.

Consider $\{o^n\} \equiv \{z^1, z^3, z^5, z^7, \dots\}$ and $\{e^n\} \equiv \{z^2, z^4, z^6, z^8, \dots\}$. Note that, since they are subsequences of $\{z^k\}$, $\{o^n\}$ and $\{e^n\}$ converge to \hat{z} . Furthermore, by continuity of H , $\{H(o^n|\theta; \hat{y}^*)\}$ and $\{H(e^n|\theta; \hat{y}^*)\}$ must converge to $H(\hat{z}|\theta; \hat{y}^*)$. In addition, we have that $\{H(o^n|\theta; \hat{y}^*)\} \subset S \times \{z_2^*\}$ and $\{H(e^n|\theta; \hat{y}^*)\} \subset \{z_1^*\} \times T$. The sets $S \times \{z_2^*\}$ and $\{z_1^*\} \times T$ are closed, and so we know that $H(\hat{z}|\theta; \hat{y}^*)$ is in the intersection of these two sets, which means that $H(\hat{z}|\theta; \hat{y}^*) = z^*$. We conclude that $z^* \in H(Q(\theta)|\theta; \hat{y}^*)$. *Q.E.D.*

Proof of Theorem I.2: For any $v \in V(y^*)$ and any mechanism (Θ^2, f) that implements it, we can easily find another mechanism (Θ^2, \hat{f}) that implements v

when \hat{y}^* is the renegotiation function instead. Letting $w^{\theta_1\theta_2} \equiv f(\theta_1, \theta_2)$ for all $\theta_1, \theta_2 \in \Theta$, define \hat{f} as follows. First, note that $w^{\theta\theta}(\theta) \in H(Q(\theta)|\theta; y^*)$ for every θ , which further implies (using Lemma I.3) the existence of another outcome $\hat{w}^{\theta\theta} \in W(y^*)$ such that $\hat{w}^{\theta\theta}(\theta) = w^{\theta\theta}(\theta)$. Define $\hat{f}(\theta, \theta) \equiv \hat{w}^{\theta\theta}$. Second, consider any pair $\theta_1, \theta_2 \in \Theta$ such that $\theta_1 \neq \theta_2$. For this message profile, define $\hat{f}(\theta_1, \theta_2) \equiv \hat{w}$ for that outcome \hat{w} identified in Lemma I.2 with $w = f(\theta_1, \theta_2)$. Clearly, honest reporting is an equilibrium in every state, with mechanism (Θ^2, \hat{f}) under renegotiation function y^* . This mechanism implements v by construction. Thus, $V(y^*) \subset V(\hat{y}^*)$. *Q.E.D.*

I.E An Example

In this section, we present an example to illustrate how the RPP fails in some settings. The example involves a hold-up problem in a bilateral contractual relationship, where the parties' ability to renegotiate interferes with their incentives to make relationship-specific investments.¹⁶ We show that, with moderate renegotiation costs, there is a contractually-specified mechanism that induces investment and implements a particular value function. Importantly, this value function can *only* be implemented by a mechanism that necessitates renegotiation.

Two risk-neutral parties, a buyer (player 1) and a seller (player 2), contract to trade one unit of an intermediate good. After forming their initial contract, the players simultaneously and independently make private investment decisions—each choosing between high and low effort. Contingent on their investment choices, the players pay private effort costs or obtain private benefits. To be precise, if both parties choose high effort then each pays 3 immediately. If both choose low effort, then each pays nothing. Finally, if player i exerts high effort while player j exerts low effort, then player i pays 3 whereas player j obtains a private gain of 4.2. Think of high effort as a reliance investment. The cost of 3 measures a party's opportunity cost of making this investment, whereas the gain of 4.2 reflects the

¹⁶Notable early papers in the hold-up literature include [33], [65], [24], [23] and [26]. Our example here is along the lines of the example in [50].

benefit of selfishly using the other party's investment. The players do not observe each others' effort choices.

The investments influence the state of the relationship, which is the buyer's value of the intermediate good. In particular, if both parties exert high effort, then the buyer's value will be 20 with probability .9 and it will be 10 with probability .1. If either party exerts low effort, then the buyer's value will be 10 for sure. The realization of the buyer's value, θ , is commonly observed by the players, though it is not verifiable to the enforcement authority (the court). We assume that the seller's cost of delivery is zero.¹⁷

The public decision x has two components, k and c , with $k \in \{T, N\}$ and $c = (c_1, c_2) \in \mathbf{R}_-^2$. The variable k indicates whether the intermediate good is traded; "T" means trade. For $i = 1, 2$, c_i is a court-enforced transfer to player i . If $c_1 + c_2 < 0$, then the court imposes a penalty. The payoffs from the public decision are given by $\tilde{u}(x|\theta)$, which is defined as follows: $\tilde{u}(T|20) = (20, 0) + c$, $\tilde{u}(N|20) = (0, 0) + c$, $\tilde{u}(T|10) = (10, 0) + c$, and $\tilde{u}(N|10) = (0, 0) + c$. Note that player 1 (the buyer) obtains his value of the intermediate good if trade occurs, plus his transfer; player 2 obtains his transfer. The costs and benefits incurred at the investment phase are sunk and not included here.

We assume that renegotiation is costly. More precisely, the parties must employ an attorney to alter the public decision. The attorney charges them a fee equal to the minimum of 10 and six-tenths of the gain from changing the default public decision. In other words, if the gain of changing the default decision exceeds $50/3$, then the attorney charges a flat fee of 10; if the gain is less than $50/3$, then the attorney charges .6 times the gain. In technical terms, if in state θ the players want to renegotiate from default decision $\underline{x} = (\underline{k}, \underline{c})$ to public decision $x = (k, c)$, then they must pay

$$\eta(x, \underline{x}|\theta) \equiv \min\{10, (.6)[\tilde{u}_1(x|\theta) + \tilde{u}_2(x|\theta) - \tilde{u}_1(\underline{x}|\theta) - \tilde{u}_2(\underline{x}|\theta)]\}.$$

¹⁷Thus, player 1's investment is an "own investment," whereas player 2's is a "cross investment" (which [11] call "cooperative").

The set of feasible renegotiation activity is thus

$$\hat{Y}(\underline{x}|\theta) \equiv \{(x, t) \mid t_1 + t_2 \leq \eta(x, \underline{x}|\theta)\}.$$

Regarding the renegotiation function y^* , we suppose that the players maximize their joint value and equally divide the surplus of renegotiation; that is, they have equal bargaining weights.¹⁸

Clearly, efficiency requires both players to exert high effort in the investment phase and for the intermediate good to be traded. If the parties do not give any money away, this would yield to them a joint payoff of

$$-3 - 3 + (.9)(20) + (.1)(10) = 13.$$

Note that the players can get no more than 11.2 if only one of them invests high, and they get only 10 if neither invests high.

The value function $v : \Theta \rightarrow \mathbf{R}^2$ gives the payoff vector from the public decision and renegotiation activity; it does not include the private costs and benefits incurred in the investment phase. The players' contractual objective is to implement a value function v that achieves the highest joint payoff, once the investment-phase gains and losses are factored in.

For example, suppose the players select a mechanism that implements the value function defined by $v(20) = (10, 10)$ and $v(10) = (5, 5)$. Then, if both players exert high effort in the investment phase, they each expect a total payoff of

$$-3 + (.9)(10) + (.1)(5) = 6.5.$$

Interestingly, this value function does not give the players the incentive to invest high; in particular, anticipating that the other player will invest high, a player obtains

$$4.2 + 5 = 9.2$$

¹⁸One can easily verify that our technical assumptions are satisfied in this example.

by exerting low effort. For the players to each have the incentive to invest high, they must implement a value function that satisfies

$$-3 + (.9)v_i(20) + (.1)v_i(10) \geq 4.2 + v_i(10)$$

for $i = 1, 2$. Rearranging terms, this is

$$v_i(20) - v_i(10) \geq 8.$$

Clearly, no efficient value function has this property.

High effort can only be achieved with a value function that represents an inefficient outcome in state 10. Define function v^* by $v^*(20) = (10, 10)$ and $v^*(10) = (2, 2)$. It is easy to verify that the following contractual mechanism implements value function v^* . The players send to the court reports of the buyer's value. If the message profile is $(20, 20)$ —that is, both players report value 20—then the default decision is trade ($k = T$) and a transfer of 10 from the buyer to the seller ($c_1 = -10, c_2 = 10$). Note that this would not be renegotiated. For the other three message profiles, the default decision is no trade ($k = N$) and no transfer ($c_1 = c_2 = 0$). Note that, in state 10, this would be renegotiated to specify trade; however, attorney's fees reduce the renegotiation surplus from 10 to 4, so each player gets 2.

By writing the contract just described, and thus implementing value function v^* , the players achieve a joint payoff of

$$-3 - 3 + (.9)(20) + (.1)(4) = 12.4,$$

which is the highest payoff that can be reached. Importantly, v^* is the optimal value function; increasing $v_i(10)$ would annul investment incentives, whereas decreasing $v_i(10)$ just reduces joint value. Furthermore, there is no way of implementing v^* without renegotiation. That is, there is no mechanism that implements v^* and does not necessitate renegotiation.

I.F Conclusion

We have developed a modeling framework to explicitly capture the constraints on implementation imposed by the noncontractible opportunity for parties to renegotiate. Our framework has allowed us to rigorously characterize conditions under which the Renegotiation-Proofness Principle is valid. We have demonstrated that the RPP generally will not apply in settings of moderate renegotiation costs. However, our monotonicity result authenticates the “renegotiation is bad” intuition that underlies the RPP. Our result establishes that the implementable set increases with the cost of renegotiation. Our results emphasize the need to properly incorporate institutional and technological constraints into mechanism-design analysis, which we unabashedly refer to as **Watson’s program** (as this paper continues the line of [62]; see also [10]). We encourage further research in this direction.

We wish to point out that our analysis can be applied in a straightforward manner to the case of *ex ante renegotiation*, where the players have the opportunity to renegotiate following realization of the state but before messages are sent to the external enforcer. One could easily restate the RPP for *ex ante* renegotiation, which would be valid if and only if an “*ex ante* Sobel Condition” holds.¹⁹ Likewise, our monotonicity result applies in the *ex ante* case.²⁰ An *ex ante* version of comprehensiveness is required.

We encourage researchers to study real renegotiation costs and further the theory of contract under institutional and technological constraints.

Joel Watson co-authored this chapter.

¹⁹Specifically, this requires defining a new renegotiation mapping to select a renegotiated mechanism, given the state and the “default mechanism,” with the possibility of expenditures at the *ex ante* stage. Then, the RPP will be valid whenever the *ex ante* renegotiation function has the appropriate fixed-point property.

²⁰Holding the *ex post* renegotiation technology and environment—defined by states, preferences and physical outcomes—fixed, if the costs of *ex ante* renegotiation activity increase, then so must the set of implementable value functions.

II

Reading Costs, Competition, and Contract Enforcement

II.A Introduction

Real world contract formation occurs in the presence of negotiation costs. In addition, institutions that enforce contracts are observed in practice to constrain the types of contracts that private parties may write. In this paper, I provide a model that relates these features of contract formation. To be specific, I identify *reading costs* as a possible source of inefficiency in contractual negotiation, and I clarify how reading costs affect contract formation, as well as parties' welfare. Reading costs exist whenever at least one party may require a substantial investment to compute the impact of a particular contract. The cost may represent the need to pay for lawyers, or one may have to forego some important activity in order to read. As my analysis reveals, the presence of reading costs implies a role for courts to limit enforcement of some contracts, since otherwise contract offers may not be read—and opportunities for productive interaction between buyers and sellers may not be realized. Also, if buyers invest positive amounts to read contract offers, courts additionally can reduce reading costs improve contract efficiency.

I consider a specific model of contract negotiation where sellers seek to

establish a contract with a buyer. Each relationship has the potential to produce an identical amount of surplus, which I normalize to one. Initially, the sellers simultaneously make contract offers, which are proposals about the division of surplus. The buyer invests to read the offers. Then, the buyer decides whether to accept one offer or to reject all. The only source of asymmetric information in the model is that the buyer is unaware of the terms in the sellers' contracts, unless the buyer reads the offers successfully. When the buyer reads the offers, she knows exactly what each specifies and is able to compute the associated payoff that is promised by any particular offer. When the buyer does not read the offers, she is ignorant of the specific terms in each, and must make the acceptance decision solely on the basis of what she expects each of the sellers to have offered. A key feature of my model is that the lower limit on enforceable offers, L , can be worse for the buyer than is the outside option. To fix ideas, consider the simple case where a seller has one unit of a good which a buyer values at 2008. The seller could write a contract that forces the buyer to pay 2009 in the event of delivery. If the buyer accepts the offer and the good is exchanged, surplus is created, but the buyer would have been (slightly) better off rejecting the deal. This is an example of a "forcing contract" in which the court compels the buyer to perform as under the written contract. [62] uses mechanism-design analysis to study contract contexts in which parties have inalienable actions which courts cannot force. [62] shows that standard mechanism design models—which ignore the possibility of writing options on inalienable decisions and focus instead on forcing contracts—must understate the true scope of opportunities for efficient contracting.

Why would the buyer have accepted the seller's offer to deliver the good at a price of 2009? The example is interesting if one believes that contracting occasionally leads to this type of outcome, where the buyer accepts a contract which is worse than the outside option. It goes without saying that standard neoclassical economic theory would be able to explain this type of outcome using some appeal to duress or fraud, or a threat to destroy value, or generally that there

must be some similar type of constraint on the choice problem of the buyer lurking in the background, unexplained and created either naturally or by the seller—but never by a third-party enforcer—and that this must have caused the buyer to be unable to make a free and fully rational acceptance decision. This is not to say that reading costs do not have a significant impact on contracting outcomes even if contracting cannot lead to an outcome in which a party accepts a contract that is worse than the outside option—which could be the case if the courts were (able) to control contract enforcement appropriately. In this case, as I demonstrate in Sections II.D and II.H, buyers will invest to read if and only if simultaneous competition among sellers takes place, and this means that reading costs will be important determinants of efficiency in contracting, as well as the way that value in contracting is distributed between buyers and sellers. In this paper, I assume that the buyer is not able to process at zero cost the implications of any contract. This leads to the possibility that the buyer, in equilibrium, will accept a contract without reading it, a contract which may be worse than the outside option. Also, why would the seller in the example not have offered to sell the good at 2009.5? Given contract enforcement, and ignoring considerations of reputation, it makes sense for the seller to specify the maximum possible price such that the buyer will accept, and, crucially, this is a buyer who is apparently willing to pay 2009 for a good she values at 2008. Finally, what price will the seller be able to specify in the contract which the buyer would be compelled to pay on delivery? This question is important, because it highlights the necessary role which limits on the enforcement of contracts play in encouraging contract formation when parties face reading costs.

In reality, many contractual relationships between buyers and sellers are more complex than this example suggests. With complicated contracts, the possibility that buyers may accept terms which are unfavorable is realistic. I argue that this realism is derived from the existence of substantial reading costs (provided something that destroys value, such as fraud, will not take place). And, in a more

complicated setting, contract offers could call for buyers who face reading costs to pay large damages in certain contingencies, contingencies which may even be likely to arise. Again, the key issue is the extent to which such terms will be enforced.

I assume that the buyer either reads every seller’s offer or does not read any offer. One can interpret the investment as being language-based.¹ When the investment succeeds, the buyer is able to read the language in every contract. When the investment fails, the buyer is not able to read the language with perfect accuracy, but forms an expectation about its content. (In equilibrium, the buyer’s expectations will be consistent with the sellers’ offer strategies.) Hence, when the buyer reads the offers, each seller will want to have given the buyer the best offer, and will want to have made an offer no worse for the buyer than is the outside option. When the buyer does not read, the buyer decides whether to accept one of the offers only on the basis of her beliefs about what the sellers have offered. This means, in particular, that investing to read the offers has value to the buyer, via the incremental increase in the likelihood that the buyer will be able to select the most favorable offer.

In Section II.D, I demonstrate that there are two types of sequential equilibria in the model. There exists an *equilibrium with reading* in which the buyer reads the offers with probability strictly between zero and one, and accepts an offer with positive probability even without reading it. The equilibrium with reading is symmetric, where the sellers select identical strategies. (Also, I provide a result on limiting equilibria, which approximate equilibria with reading for cases where the number of sellers is large, and in Section II.E I conduct a more focused analysis of limiting equilibria for the special case where the sellers are limited to a binary set of offers.)

The second type of equilibrium in the model is a *no-reading equilibrium*, in which the buyer does not invest to read the offers. In Section II.H, I analyze no-reading equilibrium for the various specifications of the contract model. To start, I

¹ [5] explicitly model contract-writing costs associated with using language to make a detailed description of the environment. [36] stresses decision makers strive to use language optimally.

show that the monopoly version of the model (with one seller) only has no-reading equilibria. In the monopoly case, if the buyer does not read, the seller will want to have offered a contract that not only takes all surplus but also extracts the maximum extra enforceable transfer from the buyer. If the lower limit on offers is worse for the buyer than is her outside option, the buyer cannot anticipate positive gain from contracting with the seller. Hence, the buyer must not choose to read or to accept, and so, will never discover whether the offer is legitimate. This is closely linked to the version of the hold-up problem—introduced by [33]—studied by [3]. [3] analyze an alternating-offers bargaining game in which the two parties must incur participation costs to be able to bargain in any particular round. And, [3] show that if the fixed participation costs are sufficiently large, the only equilibrium of the model involves no investment and no agreement. In the single-seller version of my model, there is no value to reading for the buyer, since the buyer can anticipate what the seller will have offered. Consequently, the buyer does not invest, and must reject the seller’s offer if it may be worse than the buyer’s outside option. Also, in Section II.H, I characterize the no-reading equilibria of my general model and indicate that the supporting arguments reproduce those used to characterize no-reading equilibrium in the single-seller case.

In Section II.D, I additionally use my characterization of equilibria with reading to develop comparative statics results which show that the welfare properties of the equilibrium with reading depend on two institutional variables, namely, the lower limit on enforceable offers, L , and the buyer’s marginal costs of reading. Tight limits on enforceable offers must correspond to equilibria with reading with desirable welfare properties, because the probability that a contract is established is large, even though the buyer has only a weak incentive to invest to read. Hence, tightening lower limits on enforceable offers unambiguously raises welfare.

I connect this monotonicity result on welfare with respect to the lower limit on offers with a pre-existing real institutional response. Specifically, I point out that, in common law countries, the courts refuse to enforce privately stipu-

lated damages which are punitive. This is the famous penalty doctrine considered by [21], [12], [1], [28], [59], [56], and [40]. The use of a doctrine of nonenforcement of penalties represents a real institutional restriction on the set of contract offers that are to be enforced. Consequently, my analysis suggests that reading costs provide a foundation for restrictions on privately stipulated penalties. In civil law countries, by contrast, the courts will enforce liquidated damages which are punitive. However, even in these cases, the size of the punitive measure is often reduced in court; [15]. This, too, represents activity on the part of the courts which restricts the limits on enforcement of offers.

Also, Section II.D contains another another monotonicity result which states that welfare in the equilibrium with reading is decreasing in the buyer's marginal cost of reading. This makes sense, because, when reading costs are negligible, the buyer reads the sellers' offers with high probability, inducing them to compete. In turn, the buyer is made more willing to accept an offer after not reading. Concluding with the observation that the buyer's total reading investment does not increase when incremental reading costs are reduced, it follows that joint surplus generated in the equilibrium with reading must be relatively high when reading costs are low. Again, I connect this result to a prescriptive point on real court activity. Reducing reading costs, via refusal to enforce misleading modifications to standard form agreements,² and by controlling details of standard form agreements, must raise welfare.

In Section II.B, I describe, in detail, the model of contract formation with reading costs, which I refer to as the *RCM*. In Section II.C, I describe the player's strategic incentives in the game, and define the various types of sequential equilibria. Section II.D contains analysis of equilibrium for the general model. A unique aspect of my presentation is that I define the buyer's *diligence* as the ratio of the probability that the buyer reads to the probability accepts without reading. I show that increases in the buyer's diligence correspond to first-order stochasti-

² [46] also makes the point that voiding contracts with misleading modifications and upholding ones with sincere modifications will increase joint value.

cally dominating shifts in the sellers' (symmetric) equilibrium offer distribution. Also, I characterize the equilibria with reading first for the case of a fixed number of sellers. Then, to conclude the section, I provide an approximation result on the set of equilibria with reading in the limit when the number of sellers is large. In Section II.E, I consider a specific version of the contracting model in which the sellers are constrained to make offers in a binary set $\{L, H\}$, where L and H represent shares of the surplus which the buyer receives and where $H > L$. In Section II.F, I connect these essential features of the *RCM* to practical institutional consideration, such as the nonenforcement of liquidated damages which are punitive. Also, I relate the reading technology with existing literature on bounded rationality and costly information acquisition. Finally in Section II.F, I scrutinize the validity of my assumption that the buyer either reads every offer or does not read any offer (perfect complementarity of the reading technology) and I suggest how the *RCM* framework can be extended to consider more general reading technologies. Section II.G concludes the main text of Chapter II with some suggestions on future applications. In Section II.H, the first appendix to Chapter II, I analyze the single-seller version of the model, in which hold-up arises if and only if the lower limit on offers is worse for the buyer than is the outside option, and I extend the analysis to characterize no-reading equilibria of the general model. Section II.I, the second appendix of the chapter, contains proofs of the lemmas and theorems.

II.B Contract Formation with Reading Costs

In this section, I provide a complete, detailed description of the reading costs model, or *RCM*. There are n sellers, S_1, \dots, S_n , that seek to establish a productive relationship with a buyer, B . Assume that each potential pairing, if established, will generate a surplus that is normalized to 1. Contract negotiation has a specific structure.

In **Stage 1**, the sellers make contract offers to B . Each seller i 's contract

offer x_i specifies division of the surplus, where x_i is B 's proposed slice of the pie. The offers are constrained to take values in the range $[L, 1]$, where L represents the lower limit on offers B may receive which will be enforced. Also, I consider mixed strategies for the sellers; for $i = 1, \dots, n$, a mixed strategy for seller i is represented by a cumulative distribution function (c.d.f.) $m_i : [L, 1] \rightarrow [0, 1]$. I assume the sellers do not coordinate their offers, and, instead make their offers independently.³ Also, I use the notation $\text{supp}\{m\} \equiv \{x | m'(x) > 0\}$.

In **Stage 2** of the *RCM*, B makes an investment, $e \in [0, 1]$ that represents the *probability* with which B is able to understand the language in each seller's offer. I establish specific terminology. First, if B 's reading investment is successful, then B **reads** every offer. When B reads every offer, B knows the value of every x_i . In this case, after the investment, B is at a singleton information set, knowing exactly what the sellers have offered (and her own investment choice). Second, if the investment fails, then B **does not read** any of the offers. In this case, if B does not read, after the investment, B is at an information set where she knows only her own investment, and where she has beliefs about what contracts the sellers have offered. (In any sequential equilibrium, B 's belief is that the offers are distributed in accordance with the actual mixed-strategy m^* that the sellers symmetrically choose.)

An interpretation of the reading technology is that B makes a costly attempt to learn the language in which the contracts are written; another valid idea is that the seller's contracts contain lots of legalese, and B must attend law school in order to be able to work out each contract's possible implications. And, specifically, I study the case of *perfect complementarity*, where B learns the language in one contract if, and only if, she learns the language in every contract. The case of *perfect substitutability*, where B 's effort to read a particular contract does not at all affect her ability to read other contracts reduces to the single-seller case that I

³This means I ignore the consideration of collusion among sellers. Importantly, in the real world, sellers not only would want to try to collude to offer L , but, and perhaps more significantly, they also might want to collude to write complex contracts to increase reading costs.

analyze in Section II.H.

Contract negotiation concludes with **Stage 3**, in which the buyer decides whether to accept one seller's offer. If B reads—so that B knows exactly what each seller has offered—then B will always accept $\max\{0, x_1, \dots, x_n\}$, where the outside option gives payoff 0. On the other hand, if B does not read, B makes the acceptance decision on the basis of her beliefs about the sellers' offers. Also, I let p_i signify the probability with which B accepts S_i 's offer, after she does not read the offers.⁴

I concentrate on sequential equilibria, [34], that are symmetric, in the sense that the sellers use the same strategies. The only asymmetric equilibria in the model are no-reading equilibria that exist if only if $L < 0$. In this case, there are equilibria in which the sellers make different negative offers to the buyer (possibly with various probabilities they would each make several different negative offers), and the buyer chooses not to read or to accept. Any such asymmetric no-reading equilibrium is manifestly payoff equivalent to the symmetric no-reading equilibrium in which the sellers all make the same negative offer and the buyer chooses not to read and rejects all offers.

When the sellers each choose the same mixed strategy, I let $m_1 = \dots = m_n = m$, denote a typical strategy symmetrically chosen by all n sellers, where $m \in M$. Therefore, the contract value that B gets when she reads the offers will be the maximum of (zero and) n independent and identically distributed (i.i.d.) random variables. The induced distribution of offers that B faces after reading is therefore m^n (truncated at 0 if $L < 0$).

Also, in any symmetric equilibrium, after B does not read the offers, B will choose identical acceptance probabilities, given beliefs derived from sellers' offer distributions, which are identical. So, in this case, $p_1 = \dots = p_n$, and I let p denote the total probability that B accepts some seller's offer after not reading the contracts. Indeed, the *RCM* could provide a unique perspective on reputation,

⁴Notice this assumption rules out the possibility that B 's acceptance probability would depend on the level of the reading investment.

because one could consider the possibility that B , **when she does not read**, may choose to accept any given seller's contract offer with a probability that depends on some "reputation" parameters. I ignore throughout the development and full analysis of the RCM such realistic characteristics that a buyer might attach to sellers, though, obviously, reputation can affect buyers' decisions about whether to contract with particular sellers, as well as decisions sellers make about what contracts they will offer. Indeed, this may especially be important in RCM -type environments, where it is impossible for buyers to process (at zero cost) all implications of contracts proposed by various sellers. I just assume that sellers have identical reputations, and there is no motivation to use the current contract negotiation game to affect reputation. In many situations, it may be important to make high offers to buyers to be able to establish a good reputation. [54] consider espionage in chainstore games, where an entrant can invest to spy on an incumbent, and develop a necessary and sufficient condition for the entrant to invest.

So, the timing of contract negotiation adheres to a precise and compact essential structure:

Stage 1 : S_1, \dots, S_n make offers x_1, \dots, x_n ,

Stage 2 : B reads x_1, \dots, x_n with probability e ,

Stage 3 : B either accepts some x_i or rejects all.

Next, I describe notation applied to the strategy sets for each of the players for the case where the sellers play symmetric strategies. Sellers each choose a c.d.f. m . I let $M_1 = \dots = M_n = M$ be the set of strategies available to each seller. B chooses reading investment e , where e represents the probability B reads every offer. Also, if B 's reading investment is not successful, B decides to accept some offer with probability p . I let (m, e, p) denote a typical strategy profile, and I let $\Sigma \equiv M \times [0, 1]^2$ denote the set of (symmetric) strategy profiles.

As it concerns contract enforcement, I assume that if B accepts contract offer x_i from some S_i , and if $x_i \in [L, 1]$, then x_i is enforced, sans error. Further,

I assume that the nature of enforcement does not depend on whether B reads. This implies that, when $L < 0$, the court will enforce negative offers, those worse for B than the outside option, as long as they exceed L . One consequence of this assumption is that I ignore parties' strategic decisions to disclose evidence prior to the enforcement phase. [9] argues that costs associated with actions to disclose, or to withhold, evidence are key determinants of the limits of verifiability and contract enforcement. To flesh out the nature of contract enforcement in the *RCM* a little more, I assume that the buyer is able to identify an offer as unenforceable without investing a positive amount to read it, and, therefore, that no seller will choose to offer a contract such that $x < L$.

Now that I have completed the description of the basic game form that represents the *RCM*, I establish notation representing payoffs of B and S_1, \dots, S_n . To start, accepting offer $x \in [L, 1]$ gives B payoff x . The **reading cost function**, $c(e)$, represents the cost to B of investment e . B 's total payoff, associated with accepting an offer of x after choosing reading investment e , is additive:

$$u_B(x, e) \equiv x - c(e).$$

This payoff representation is valid, for instance, if x and $c(e)$ are both monetary values and if B is risk-neutral. If S_i 's offer of x is accepted, S_i 's total payoff is:

$$u_{S_i}(x) \equiv 1 - x.$$

Notice that I assume the sellers are also all risk-neutral. Players that do not establish a contractual relationship get the payoffs, which equal zero, associated with their outside options.

Next, I establish some additional notation on continuation values that B expects, at different points in the game, given an arbitrary offer distribution symmetrically chosen by the sellers. For any $m \in M$, define:

$$v_B^{nr}(m) \equiv E[x|x \sim m] \equiv \int_L^1 x dm(x).$$

This is just the expected offer given the choice of m , and notice v_B^{nr} also represents the payoff B expects from accepting when she does not read any offers, if all of the sellers choose mixed strategy $m \in M$. Next, for any $m_1 = \dots = m_n = m$, let:

$$\begin{aligned} v_B^r(m) &\equiv E[\max\{x_1, \dots, x_n, 0\} | x_i \sim m, \text{ for } i = 1, \dots, n] \\ &\equiv \int_L^1 \dots \int_L^1 \max\{x_1, \dots, x_n, 0\} dm_1(x) \dots dm_n(x) \end{aligned}$$

By definition, $v_B^r(m)$ is the payoff that B expects, given successful reading, because, in this state, B selects the best offer or rejects all if they are negative. The key observation is that $v_B^r(m) \geq v_B^{nr}(m)$ for any $m \in M$, meaning there generally is a value to the buyer associated with reading the sellers' contracts. Further, v_B^{nr} may be negative when L is.

I make the following assumption on the buyer's reading cost function.

Assumption II.1: *The reading cost function $c(e)$ is strictly convex, with $c(0) = 0$, $c(1) > 1$, $c'(0) = 0$, and $c'(1) > 1$.*

Also, define \bar{e} to satisfy $c'(\bar{e}) = 1$, and notice $\bar{e} < 1$. The buyer will never select a reading investment larger than \bar{e} , since the marginal benefit of reading cannot exceed the total surplus created in any partnership between B and one of the sellers (and since no seller will offer a contract that would transfer a positive amount to the buyer).

Assumption II.1 guarantees a unique, interior solution to the maximization problem that B faces when choosing her level of reading investment. Replacing strict convexity with a weaker continuity assumption (strict convexity implies continuity) does not affect existence of equilibrium in the *RCM*, though uniqueness of an equilibrium in which the buyer reads contracts with positive probability is no longer guaranteed. This completes the description of the reading costs model; I next establish helpful classification of sequential equilibrium in the *RCM*.

II.C Equilibrium with Reading in the *RCM*

In this section, I develop three conditions that effectively characterize the symmetric sequential equilibria of the model. These conditions apply for any lower limit on offers $L < 1$, for any number of sellers $n \geq 2$, and for any specification of the buyer's reading cost function satisfying Assumption II.1. First, I present the relevant equilibrium conditions for the buyer.

For an arbitrary $m \in M$, define the correspondence:

$$P(m) \equiv \begin{cases} 1 & \text{if } v_B^{nr}(m) > 0 \\ [0, 1] & \text{if } v_B^{nr}(m) = 0 \\ 0 & \text{if } v_B^{nr}(m) < 0 \end{cases} .$$

Then, in equilibrium, the buyer's probability p of accepting after not reading must satisfy:

$$p^* \in P(m). \tag{II.1}$$

Condition II.1 makes clear that the buyer will accept a contract for certain, after not reading the offers, if the sellers choose an offer distribution that has strictly positive expected payoff for B . Also, after not reading the offers, the buyer will not accept a contract if the sellers each use mixed strategies with a strictly negative no-reading payoff for the buyer. Finally, if the sellers use mixed strategies in which the expected offer is exactly equal to the value of B 's outside option, then B is indifferent between accepting and rejecting after not reading. In this case, B 's equilibrium acceptance probability is not restricted according to Condition II.1.

Next, I consider B 's incentive to invest to read the seller's offers; this evidently depends on the nature of the sellers' strategies, and on B 's reading cost function. If the sellers each choose the mixed strategy m , and if B chooses acceptance probability $p \in P(m)$, then B , in a sequential equilibrium, must select the reading investment e to maximize:

$$e \cdot v_B^r(m) + (1 - e) \cdot p \cdot v_B^{nr}(m) - c(e),$$

which is equivalent to maximizing the value:

$$e[v_B^r(m) - p \cdot v_B^{nr}(m)] - c(e).$$

As this specification of B's reading problem makes apparent, B's reading investment raises the probability that B gets continuation value $v_B^r(m)$ rather than $v_B^{nr}(m)$, where, remember, it is always the case that $v_B^r(m) \geq v_B^{nr}(m)$ for any m . Of course, the cost of reading is increasing in the reading investment, according to Assumption II.1.

Also given Assumption II.1, B's reading cost function $c(e)$ is differentiable—that is, $c'(e)$ always exists—and so the solution to the buyer's reading problem satisfies:

$$c'(e^*) = v_B^r(m) - p \cdot v_B^{nr}(m). \quad (\text{II.2})$$

It is apparent, from Condition II.2, that, in a sequential equilibrium, the buyer will choose the level of reading investment at which the marginal benefit of reading exactly equals the marginal cost of reading. Given strict convexity of the buyer's reading cost function, it is clear that investing less than the amount indicated in Condition II.1 would mean that the buyer was not fully exploiting the capability to be able to read the offers and choose the highest one, while investing more would mean that the buyer was expending too much effort reading the offers, relative to the payoff that would be obtained by ignoring the offers but accepting one anyway.

In the *RCM*, there are two separate avenues the buyer uses to induce the sellers to improve their offers. First, the buyer can invest at a high level, making it likely that she will read the sellers' offers, and will be able to select the highest offer or to reject all offers if they are worse than the outside option. The buyer can also induce the sellers to compete by accepting with low probability when she does not read the offers. For any level of the reading investment, this makes it relatively more likely that a seller's offer will need to be the best for the buyer if it is to be accepted.

It is useful to consider these two avenues together. Specifically, I term the ratio of the probability that the buyer reads to the probability the buyer accepts without reading the buyer's **diligence**. And, θ represent the reciprocal of diligence with the parameter:

$$\theta \equiv \frac{(1-e)p}{e}.$$

Straightforward analysis, expressed in Lemma II.1, reveals that sellers have the incentive to respond to an increase in the buyer's diligence with first-order stochastically dominating shifts in their mixed-strategy offer distributions. When θ is *small*, it reflects the fact that the buyer's strategy puts pressure on the sellers to compete. One should note that diligence controls the probability with which high and low offers are accepted. Specifically, when the buyer is diligent, there is a relatively large difference in the acceptance probabilities associated with offering some $x \geq 0$ and offering L . In contrast, when the buyer is not diligent, these acceptance probabilities must be relatively similar, and the sellers find it attractive to offer L .

To conclude the presentation of the basic equilibrium conditions, I consider the sellers' incentives to make offers. Suppose B chooses some strategy (e, p) . A strategy $m^* \in M$ for every seller will be part of a symmetric sequential equilibrium only if the following condition holds for any two offers $x, y \geq 0$ such that $x, y \in \text{supp}\{m^*\}$:

$$(1-x) \cdot [e \cdot (m^*(x))^{n-1} + (1-e) \cdot \frac{p}{n}] = (1-y) \cdot [e \cdot (m^*(y))^{n-1} + (1-e) \cdot \frac{p}{n}].$$

Furthermore, when $L < 0$ and $L \in \text{supp}\{m^*\}$, the above payoffs must also equal the payoff of offering L , (given B 's strategy) which is:

$$(1-L) \cdot (1-e) \cdot \frac{p}{n}.$$

First, $(m^*(x))^{n-1}$ is the distribution of the maximum offer made by the other $n-1$ sellers; and it is the probability that a seller's offer of x is the largest when each of the $n-1$ other sellers uses mixed strategy m^* .⁵

⁵This formulation relies on my assumption that sellers' offers are not correlated; they do not collude.

In words, the requirement states that any seller is indifferent between offering x and y (with probability 1), when B uses strategy (e, p) and when all of the other sellers use strategy m^* . Notice the terms in brackets on the left-hand side of the above equation is exactly the probability that the offer x will be accepted when $x \geq 0$ and when every other seller uses mixed strategy m^* .

Also, an offer of $L < 0$ is accepted only if the buyer does not read but chooses to accept anyway. Given the goal of characterizing sequential equilibrium in the *RCM*, it is enough to consider offer distributions in which the sellers make offers in the set $(L, 0)$ with probability 0. To see this, notice that the probability that B will accept a negative offer (which happens only if B does not read but accepts anyway) does not depend on the magnitude of that offer, and, consequently, when $L < 0$, sellers must strictly prefer to offer L rather than any $y \in (L, 0)$. And, when $L \geq 0$, the set $(L, 0)$ does not exist.

Next, I rearrange the sellers' indifference condition above to determine that, when B uses some diligence level θ , the sellers must choose distribution m such that:

$$m^*(\theta) \equiv \begin{cases} 0 & \text{if } x < L \\ \left[\frac{\theta}{n} \cdot \frac{(z(x)-L)}{(1-z(x))}\right]^{\frac{1}{n-1}} & \text{if } x \in [L, H^\theta) , \\ 1 & \text{if } x \geq H^\theta \end{cases} \quad (\text{II.3})$$

where $H^\theta \equiv \frac{n+\theta \min\{0, L\}}{n+\theta}$; and $z(x) \equiv \max\{0, x\}$. As the specification of Condition II.3 makes clear, the sellers will choose to react to the buyer's level of diligence by adjusting their mixed strategies.

To fix ideas, I consider a special case of the *RCM*. Suppose, for the moment, that we are in the duopoly case; $n = 2$. And, suppose that enforcement is defined so that B must receive a payoff of at least $L = 0$ for a contract to be valid. Then, if B chooses $e^* = \frac{1}{3}$ and $p^* = 1$, the sellers' indifference condition can be simplified. For any $x \in [0, 1]$, we need:

$$(1-x) \cdot \left[\frac{1}{3} \cdot (m^*(x))^{2-1} + (1-\frac{1}{3}) \cdot \frac{1}{2}\right] = (1-0) \cdot (1-\frac{1}{3}) \cdot \frac{1}{2},$$

which is valid if and only if:

$$(1 - x)(m^*(x) + 1) = 1.$$

Additionally, the maximum contract offer that the sellers will make is determined by the condition: $(1 - H)(1 + 1) = 1$, implying $H = \frac{1}{2}$. Consequently, in the case where $n = 2$, $L = 0$, $p = 1$, and $e = \frac{1}{3}$, Condition II.3 requires that the sellers select:

$$m^*(x) \equiv \begin{cases} 0 & \text{if } x < 0 \\ \frac{x}{1-x} & \text{if } x \in [0, \frac{1}{2}) \\ 1 & \text{if } x \geq \frac{1}{2} \end{cases} . \quad (\text{II.4})$$

Using the induced symmetric offer distribution m^* , we can compute the value of reading.

To start, given that both sellers choose m^* , each seller's expected offer has to be:

$$\begin{aligned} v_B^{nr}(m^*) &= \int_0^{\frac{1}{2}} x dm^*(x) \\ &= \int_0^{\frac{1}{2}} x D_x \left[\frac{x}{1-x} \right] dx \\ &= \int_0^{\frac{1}{2}} \frac{x}{(1-x)^2} dx \\ &= \frac{1}{1-x} + \ln(1-x) \Big|_0^{\frac{1}{2}} \\ &= 1 - \ln 2. \end{aligned}$$

Then, to compute the marginal value of B 's reading investment, we need to compare $v_B^{nr}(m^*)$ to B 's payoff after she reads.

Recall that m^n equals the c.d.f. of the maximum of n i.i.d. random variables that have c.d.f. m . This is enough to determine v_B^r , since we are analyzing

a case where $L \geq 0$. As a consequence:

$$\begin{aligned}
v_B^r(m^*) &= \int_0^{\frac{1}{2}} x D_x[(m^*(x))^2] dx \\
&= \int_0^{\frac{1}{2}} x \{2m^*(x) D_x[m^*(x)]\} dx \\
&= \int_0^{\frac{1}{2}} \frac{2x^2}{(1-x)^3} dx \\
&= \left. \frac{(4x-3)}{(1-x)^2} - 2 \ln(1-x) \right|_0^{\frac{1}{2}} \\
&= 2 \ln 2 - 1.
\end{aligned}$$

And B 's value of reading is therefore:

$$\begin{aligned}
v_B^r - v_B^{nr} &= 2 \ln 2 - 1 - (1 - \ln 2), \\
&= 3 \ln 2 - 2.
\end{aligned}$$

This means that in the duopoly case where $L = 0$, the marginal value of reading is about $\frac{1}{12}$ of total surplus when B chooses to read with probability $e = \frac{1}{3}$. In Section II.D below, I consider this duopoly example in greater detail, and I use these computations to characterize the equilibrium with reading for this specification of the *RCM*.

Condition II.3 leads to the first lemma, which relates the buyer's chosen level of diligence to the sellers' resulting offer strategies. For any two c.d.f.'s m and μ , m **first-order stochastically dominates** μ if, for every $x \in [L, 1]$, it is the case that $m(x) \leq \mu(x)$.

Lemma II.1: *If $\theta \geq \psi$, then $m^*(\psi)$ first-order stochastically dominates $m^*(\theta)$.*

Lemma II.1 states that, an increase in B 's diligence, which corresponds to a decrease in θ , induces a first-order stochastically dominating shift in the symmetrically chosen mixed strategy offer distribution $m^*(\theta)$ that is defined by Condition II.3. Importantly, we see the sellers are induced to improve their offers, through simultaneous competition for the opportunity to contract with B , when

B chooses a high level of diligence. An immediate consequence is that $v_B^r \circ m(\theta)$ and $v_B^{nr} \circ m(\theta)$ are decreasing functions.

Next, I state the basic equilibrium definitions for the contracting model with reading costs. The conditions II.1, II.2, and II.3, are combined to determine to the following definition of sequential equilibrium, which I maintain throughout my analysis of the *RCM*.

Definition II.1: (m^*, e^*, p^*) is a **(symmetric) sequential equilibrium of the *RCM*** if: B chooses $\max\{x_1, \dots, x_n\}$ after reading, or rejects all offers if they are negative; p^* satisfies Condition II.1 when S_1, \dots, S_n choose m^* ; e^* satisfies Condition II.2 when S_1, \dots, S_n choose m^* ; and, finally, m^* satisfies Condition II.3 when B chooses e^* and p^* .

Throughout the remainder of Chapter II, I will also equivalently refer to any (m^*, e^*, p^*) satisfying Definition II.1 simply as an equilibrium. Notice that the requirement of sequentially rational decision-making on the part of the buyer has the effect of eliminating from the equilibrium set some Nash equilibrium strategy profiles that exist given unrealistic threats to reject which B could make. After reading, B could threaten to reject offers which are better than the outside option. Also, after not reading, B could reject even if she anticipates (given some beliefs about the sellers' mixed strategies) an offer better than the outside option.

The *RCM* in fact has two basic types of equilibria. In the first type of equilibrium, the buyer does not invest to read the sellers' offers, but still may accept one anyway.

Definition II.2: (m^*, e^*, p^*) is a **no-reading equilibrium** if (m^*, e^*, p^*) is a sequential equilibrium of the *RCM* and if $e^* = 0$.

Section II.H, contains a characterization of no-reading equilibrium in the contracting model with reading costs. Generally, in the *RCM*, a no-reading equilibrium always exists. Further, in the single-seller case of a monopoly, the contracting model with reading costs *only* has no-reading equilibria, because B , knowing the

limit on offers, L , can anticipate what the monopoly seller will have offered. I demonstrate, in Chapter III, that this basic result extends to the case where two-sided asymmetric information exists between B and S —the monopolist-seller.

Also, depending on the values of the parameters that define the *RCM*, and specifically the lower limit on offers, L , and B 's reading cost function, $c(e)$, there may exist two separate types of equilibria in which the buyer invests a positive amount to read the offers.

Definition II.3: (m^*, e^*, p^*) is an *equilibrium with reading* if it is a sequential equilibrium of the *RCM* and if $e^* > 0$.

Furthermore, if $e^* \in (0, 1)$ and $p^* = 1$, then (m^*, e^*, p^*) is a **boundary equilibrium**; or if $e^* \in (0, 1)$ and $p^* \in (0, 1)$, then (m^*, e^*, p^*) is an **interior equilibrium**.

Notice it is at least somewhat fascinating that the (admittedly natural) knee-jerk reaction to call a boundary equilibrium something more intuitive and, surely, more descriptive, such as a “*full-acceptance equilibrium*” or, even more intuitively, a “*complete-contract equilibrium*,” and, also the subsequent reflex compulsion to label an interior equilibrium with a more intuitive name, perhaps a “*partial-acceptance equilibrium*” or an “*incomplete-contract equilibrium*,” is misguided, because, even if $p^* = 1$, so that B necessarily will accept after not reading the offers, when n is finite, as long as $L \ll 0$, meaning that there are enforceable contracts which would yield B a continuation payoff that is much lower than that of the outside option, B might end up reading every offer and verifying that each one equals L , and then she would choose to take the outside option; although, this observation is not correct when $n \rightarrow \infty$, because, in any limiting equilibrium with reading the buyer will, with probability 1, receive some offer $y > 0$ (which is obviously required for B ever to get tantalized by chance to read the sellers' contracts). This is clarified in Section II.D.

To conclude this section, I establish some additional notation. Let Γ denote the set of equilibria; i.e., the set of strategy profiles in Σ that satisfy Definition II.1. Similarly, let Γ^{NR} be the set of no-reading equilibria; let Γ^I be the set

of interior equilibria; and let Γ^{II} be the set of boundary equilibria. Let Γ represent the set of equilibria with reading. Notice Γ^I and Γ^{II} are disjoint, and so are Γ^{NR} and Γ^R . Finally, notice that $\Gamma^R = \Gamma^I \cup \Gamma^{II}$, because the *RCM* cannot have an equilibrium in which the buyer reads the sellers' offers with probability 1.⁶ If the sellers anticipate that the buyer surely will read all of their offers, they will compete away all surplus and each make the best possible offer to the buyer. This, of course, eliminates the buyer's incentive to read.

II.D Equilibrium Analysis: General Case

This section contains characterization and discussion of sequential equilibria with reading in the *RCM* for the general case where the sellers make offers in the interval $[L, 1]$. First, I show that an interior equilibrium exists and a boundary equilibrium does not exist if $L < L^*$ for an appropriately defined cut-off value L^* . I also conjecture that a boundary equilibrium with reading exists whenever $L \geq L^*$, and I construct a boundary equilibrium in a duopoly example ($n = 2$) with $L = 0$ so that a contract must offer B what the literature calls an “individually rational” payoff if it is to be enforced. Then, the final part of the section, focusing on cases with a large number of sellers, contains an approximation of reading equilibrium, via characterization of **limiting equilibrium**.

Theorem II.1: *Suppose that:*

$$L < \frac{n\bar{e}}{\bar{e} - 1}.$$

Then a boundary equilibrium does not exist and a unique interior equilibrium exists.

See Section II.I for proofs not contained in the main text of this chapter. Here is concise description of the proof. First, Condition II.3 can be used to determine that whenever $L < 0$, there is a unique level of diligence (and an implied θ^*) such that $v_B^{nr} \circ m^*(\theta^*) = 0$. This is used to identify the unique e^* that satisfies

⁶This is true regardless of the form of the buyer's reading cost function; i.e. it does not depend on whether Assumption II.1 is valid.

Condition II.2. Finally, p^* is not restricted by Condition II.1 when the sellers' expected offer is zero, and to achieve the diligence level associated with θ^* , given e^* , I show that $L < \frac{n\bar{e}}{\bar{e}-1}$ implies $p^* \in (0, 1)$.

To flesh out the essential interpretation of the cutoff value L^* identified in Theorem II.1, consider this example, the facts of which are based on the recent story, "Warnings to Know Before Saying 'I Do' to Your Wedding Dress," which I have taken from the local San Diego program *10News*⁷: a bride-to-be pays \$4000 on her credit card for a gown to be made to match one that she has tried on in a local bridal shop. Then, she signs a contract containing a clause which states that she will pay $\frac{3}{5}$ of the value of the dress, that is $\frac{3}{5} \times \$4000 = \2400 , if she decides later that she would like to cancel the order. (It is an emotional purchase.) The next day, she decides that she wants to cancel the order, and she plans to go out find a more suitable dress. At this point she calls the store and realizes she is on the hook for the cancelation fee. The owner of the bridal shop explains that the process of making the finely tailored dress is initiated once the buyer, in this case she, the bride-to-be, has signed the contract, although when questioned further, the owner will not disclose how far along the store is in the process of putting together her new gown (it is after all just the next morning after completion of the sale; "how much could they have done already when the gown was going to take them six months to finish?" she asks herself). Moreover, the owner continues, the $\frac{3}{5}$ cancelation rate is standard in the industry, and she asserts that the buyer will encounter exactly this sort of clause, with the same rate, associated with whatever type of customized gown she ultimately decides to purchase. The bride-to-be, confronted only now with these revelations about the standard operating procedure of the retail bridal gown industry as well as with the newly acquired full knowledge of the nature of the contract that she signed yesterday, agrees over the phone to have the \$2400 fee assessed to her credit card and then immediately ends her conversation with the utterly shrewd, seemingly centrally profit-driven shop

⁷The story is available at: www.10news.com/investigations/11109642/detail.html

owner, whose *sang-froid* and aloofness would be emblazoned on the consciousness of young bride-to-be literally for decades to come; very flustered and now out an additional and apparently wasted \$2400, but at the same time no less ready to seek out and find her perfect wedding dress, she starts to surf the web in earnest, with the intent to locate information on bargain price name brand bridal gowns, going crazy thinking about how she might explain her recent expense to everybody in her life who has expressed an opinion over the last nearly twenty-four hour period in which she has now flirted expensively with the final purchase of the quintessential “dress of her dreams.”

There is a concrete and motivating analogy to draw between *homo economicus*'s independent reading of the “Buffalo buffalo” sentences in my analysis of the complementarity of reading technology⁸ and the buyer's *differential knowledge* of the nature of the contract at the time of contract formation and after acceptance in the wedding dress example. And, a similar kind of acquisition of knowledge after acceptance takes place when firms use the type of *shrink-wrap contracts* discussed in Footnote III.1.

In the final analysis, the bride-to-be has transferred \$2400 to the shop and has received nothing, though her reading costs were apparently negligible. Also, the shop has received \$2400 from the buyer and has delivered nothing, and the shop has incurred unverifiable production costs associated with initiating the process of making the gown and carrying through for about one day out of the estimated six month development window. Therefore the cancelation payment of \$2400 was approximately equivalent to $\$2400 \div (\$5600 - \$2400) = \frac{3}{4}$ of the size of the surplus, where I have assumed that the production cost of the dress equals \$2400 and that the buyer receives a benefit of \$5600 from the dress, so that the price of \$4000 is set to evenly split the “infinite” surplus value of \$3200 created in the production and trade of the dress. Since this is a standard fee in the industry, a bridal shop might not be able to get a larger term enforced, in which case the

⁸See Subsection II.F.3 for more details.

current contract enforcement environment is essentially setting the lower limit on offers to be $\hat{L} = -\frac{3}{4}$. Whether this is severe enough, according to Theorem II.1, to induce an interior equilibrium depends on the extent to which there is competition in the industry, via the parameter $n \geq 2$, and on the costs of reading contracts faced typically by brides-to-be, via $\bar{e} \in (0, 1)$ (where recall $c'(\bar{e}) = 1$).

If we restrict attention to competition among sellers that were within the bride's locality, at least sufficiently so that she would be able to visit any of the stores and, crucially, to try on a dress and make an apposite decision, within, for instance, one six-hour period, then we can do a phone book estimate to guess that $\hat{n} = 19$, with the bride-to-be shopping in the northern part of San Diego County. Also, in first watching this *10News* story, and in every private conversation about the story that I have had since my original viewing, I have been able to determine that we can think of the contract that the bride signed as being one page in length. (Notice that I am ignoring the third-party interaction with the bride-to-be's credit card company and how the contractual structure under which it is governed and controlled is affected). Also, in a later letter sent to *10News*, the shop owner explains that the salespersons working in the store always clearly explain the cancellation fee before the customer signs the deal. We can safely take this second fact and combine it with the lack of any known suggestion to its contrary on the part of the bride-to-be to conclude that there were probably no strong barriers to understanding erected by anybody representing the shop and nothing that would suggest significant or noticeable procedural unconscionability. Therefore, I will assume that $\hat{e} = \frac{19}{20}$, and I will see whether it seems likely that the observed enforcement limit of $\hat{L} = -\frac{3}{4}$ could possibly be consistent with an interior equilibrium in this example. Specifically, the guess is that: $L^* = -\frac{\hat{n}\hat{e}}{1-\hat{e}} = -19^2$ which is not close to the observed value of $\hat{L} = -\frac{3}{4}$.

I assert also that an equilibrium with reading exists in the *RCM* for any given lower limit on offers; where, if L is sufficiently attractive for B , then there will be an interior equilibrium but otherwise there will be a boundary equilibrium.

To understand better how a boundary equilibrium is constructed, I return for the moment to my analysis of the specific case that I started to analyze in Section II.C, where there is a duopoly, $n = 2$, and where $L = 0$.

Specifically, it was shown that, if B chooses $e^* = \frac{1}{3}$ and $p^* = 1$, the sellers' indifference condition implies they both must choose the mixed-strategy m^* given in Condition II.4. Now, B must choose $p^* = 1$ in any sequential equilibrium of the *RCM* where the sellers choose $m = m^*$, because $v_B^{nr}(m^*) > 0$. Next, I calculate the median approximations of the continuation values $v_B^r \circ m^*$ and $v_B^{nr} \circ m^*$, to help to determine that a cost function, $c(\cdot)$, exists, fitting the description in Assumption II.1, such that $e^* = \frac{1}{3}$ satisfies Condition II.2 when $p^* = 1$ and when both sellers choose $m = m^*$. Let x^{nr} solve $m^*(x^{nr}) = \frac{1}{2}$ and let x^r solve $(m^*(x^r))^2 = \frac{1}{2}$. This yields $v_B^{nr}(m^*) \approx x^{nr} = \frac{1}{3}$ and

$$v_B^r(m^*) \approx x^r = \frac{1}{1 + \sqrt{2}},$$

which means that $e^* = \frac{1}{3}$ will satisfy Condition II.2 if the parameter a in reading cost function $k(e) = ae^2$ is approximately:

$$a = \frac{2 - \sqrt{2}}{2(1 + \sqrt{2})}.$$

Then, $(m, e, p) = (m^*, \frac{1}{3}, 1)$ is a boundary equilibrium with reading, for the special case of the *RCM* where there is a duopoly and $L = 0$, when B 's reading cost function is approximately $k(\cdot)$.

Next, I approximate the equilibrium of the contracting model with reading costs for the case where the number of sellers is large. To obtain the characterization of limiting equilibrium with reading, in Section II.I, I compute first the limits of the three equilibrium conditions, which are upper-hemicontinuous in the number of sellers. Then, I demonstrate that an arbitrary sequence of equilibria, $(m_n^*, e_n^*, p_n^*)_{n=2}^\infty$, which is indexed to depend on the countably infinite number of sellers n , must have a subsequence which converges to the limiting equilibrium strategy profile.

To start, I consider the case where the enforcement boundary is defined so that L is worse for the buyer than is her outside option. Notice that any arbitrary sequence of equilibria with reading will contain a convergent subsequence, because Σ , the set of strategy profiles, is compact.⁹

Theorem II.2: *Fix $L < 0$ and let*

$$\bar{m}(x) = \begin{cases} 0 & \text{if } x < L \\ \frac{1}{1-L} & \text{if } x \in [L, 1) \\ 1 & \text{if } x \geq 1 \end{cases} .$$

Suppose $(m_n^, e_n^*, p_n^*)_{n=2}^\infty$ is a convergent sequence of equilibria with reading. Then $(m_n^*, e_n^*, p_n^*)_{n=2}^\infty \rightarrow (\bar{m}, \bar{e}, 0)$.*

In particular, Theorem II.2 demonstrates that $\bar{m} \in M$ is a simple probability distribution, where any particular seller offers L with positive probability and offers 1 (which gives B the full surplus) with complementary (positive) probability. Also, in the limiting equilibrium with reading, B selects \bar{e} , because the facts $v_B^{nr}(\bar{m}) = 0$ and $v_B^r(\bar{m}) = 1$ imply that the marginal value of reading equals 1.

The next theorem describes limiting equilibrium for the case where the lower limit on offers exceeds the buyer's outside option. Again, this limiting equilibrium approximates the set of equilibria with reading for a large number of sellers.

Theorem II.3: *Fix $L \geq 0$ and let:*

$$\underline{m}(x) = \begin{cases} 0 & \text{if } x < L \\ 1 & \text{if } x \leq L \end{cases} .$$

Suppose that $(m_n^, e_n^*, 1)_{n=2}^\infty$ is a convergent sequence of boundary equilibria. Then $(m_n^*, e_n^*, 1)_{n=2}^\infty \rightarrow (\underline{m}, 0, 1)$.*

Theorem II.3 states that any sequence of boundary equilibria, indexed by the number of sellers, converges to a limiting equilibrium in which the sellers each make the lowest possible offer. In the limit, the buyer does not read, but accepts

⁹This is obviously true, additionally, for the Binary-Offers case of the *RCM* analyzed in II.E.

since $L \geq 0$. This completes the characterization of limiting equilibria for the general contract model with reading costs.

The characterizations of limiting interior and boundary equilibria contained in Theorems II.2 and II.3 lead to simple results on comparative statics. The first result makes clear how the limiting equilibrium of the *RCM* depends on the lower limit on enforceable offers that the buyer may receive.

Corollary II.1: *Fix $L \geq \tilde{L}$. Suppose (m, e, p) is the limiting equilibrium with reading when x is enforceable if and only if $x \geq L$ and that $(\tilde{m}, \tilde{e}, \tilde{p})$ is the (limiting) equilibrium with reading when x is enforceable if and only if $x \geq \tilde{L}$. Then, $e \leq \tilde{e}$, $p \geq \tilde{p}$, and m first-order stochastically dominates \tilde{m} .*

As this corollary clarifies, restricting enforcement of contract offers to those that promise the buyer at least some benchmark level of utility in the continuation phase governed by the contract (corresponding to a relatively high value of L) induces the buyer to accept with relatively high probability after not reading the offers, since there is less of a motive to be cautious. Also, in this case, the buyer will read with lower probability, because the restricted range of possible offers means that the buyer has less of an incentive to invest to determine which seller has offered her the most favorable contract.

Theorems II.2 and II.3 also imply a natural corollary that describes how the limiting equilibrium with reading depends on the buyer's reading cost function. Specifically, the buyer's incremental reading cost has a monotonic effect on the equilibrium through the buyer's reading problem, Condition II.2.

Corollary II.2: *Consider reading cost functions c and \tilde{c} such that $c'(\epsilon) \leq \tilde{c}'(\epsilon)$, for any $\epsilon \in [0, 1]$. If (m, e, p) is the limiting equilibrium with reading when B 's reading cost function is c , and if $(\tilde{m}, \tilde{e}, \tilde{p})$ is the limiting equilibrium with reading when B 's reading cost function is \tilde{c} , then $e \geq \tilde{e}$, $p = \tilde{p}$, and $m = \tilde{m}$.*

Notice that the result obtains for an arbitrary lower limit on offers, L , but that it is trivial when $L \geq 0$, since, in this case, using Theorem II.3, we can see that the

reading investment is zero in every limiting equilibrium. In the limiting equilibrium with reading, the buyer's acceptance probability and the sellers' symmetric equilibrium offer distribution both do not depend on the buyer's reading costs, and are completely determined by the lower limit on enforceable offers. However, when the buyer's marginal reading costs are relatively low (as in Corollary II.2, for any value of the buyer's reading investment), the buyer reads with high probability. Since the buyer's total equilibrium reading expenditure does not increase—the sellers do not change their offers—this implies that total welfare must increase in response to a reduction in the buyer's incremental reading costs. In the next section, I focus analysis on a specific case of the general *RCM*, in which the sellers are constrained to making offers in the binary set $\{L, H\}$.

II.E The Case of Two Contract Offers

In this section, I consider a version of my contracting model with reading costs in which the sellers are constrained to make offers in a binary set $\{L, H\}$ with $1 > H > z(L)$.¹⁰ I call this the *Binary-Offers case* of the *RCM*. In this section, I characterize the symmetric sequential equilibrium for the Binary-Offers case and for the limiting environment when the number of sellers is large.

Also, in the second part of this section, I use the characterization of limiting equilibrium to develop comparative statics results that reveal: the expected joint surplus associated with the equilibrium with reading is monotonic in two institutional variables, namely, L , the lower of the two possible contract offers, and the buyer's marginal cost of reading, c' .

In the Binary-Offers case, the sellers' offer distributions can be summarized using the probability with which they make offer L . Specifically, let q_i denote S_i 's probability of offering L , where $(q_i, L; 1 - q_i, H) \in M$. Further, I let $q_1 = \dots = q_n = q$ denote the probability that any particular seller submits the low offer, again restricting attention to strategy profiles that are symmetric in that all

¹⁰Recall that I use the notation $z(x) = \max\{x, 0\}$.

sellers choose the same (possibly mixed) strategy. Finally, I let (q, e, p) signify a typical symmetric strategy profile in the Binary-Offers case.

First, I reexpress Condition II.3 of Section II.C, the sellers' indifference condition, for the Binary-Offers case. To do this, it is necessary to consider the appropriate analog of m^{n-1} in Condition II.3, which, recall, gives the probability that a particular seller's offer of x is the largest when all of the other sellers choose offer distribution m . This is straightforward. Consider the function:

$$\gamma(q, n) \equiv \sum_{k=0}^{n-1} \frac{1}{k+1} \cdot \binom{n-1}{k} \cdot q^{n-k-1} \cdot (1-q)^k.$$

Notice $\gamma(q, n)$ represents the probability that a seller's offer of H is accepted, when the buyer reads all offers, and when all of the other sellers offer L with probability q .¹¹ Also, $\gamma(q, n)$ is essentially a binomial distribution, with the extra "tie-breaking" terms $\frac{1}{k+1}$, reflecting the fact that, when any group of $k+1$ sellers offers H , and when the buyer reads the offers, I assume the buyer is equally likely to accept any seller's offer of H . (I have already commented, in Section II.B, on the possibility that the sellers' reputations may affect B 's acceptance decision after she does not read.)

The characterization of limiting equilibrium for the Binary-Offers case of the *RCM* employs the following lemma, which can be proved easily by direct computation.

Lemma II.2: $\lim_{n \rightarrow \infty} n \cdot \gamma(q, n) = \frac{1}{1-q}$.

This lemma facilitates the approximation of limiting equilibria with reading in the Binary-Offers case of the *RCM*.

Given Lemma II.2, the limit, as $n \rightarrow \infty$, of the sellers' indifference condition can be rewritten:

$$(1-L) \cdot (1-e) \cdot p = (1-H) \cdot \left[e \cdot \frac{1}{1-q} + (1-e) \cdot p \right]. \quad (\text{II.5})$$

¹¹ $\binom{m}{0} \equiv 1$.

This equation is valid if and only if:

$$q(\theta) = 1 - \frac{1}{\theta} \cdot \frac{(1-H)}{(H-L)},$$

where θ represents the buyer's chosen level of diligence. It is easy to see that $\theta \geq \psi$ implies $q(\theta) \geq q(\psi)$. Therefore, $(L, q(\psi); H, 1 - q(\psi))$, first-order stochastically dominates $(L, q(\theta); H, 1 - q(\theta))$, confirming Lemma II.1 of Section II.D for the Binary-Offers case with $n \rightarrow \infty$.

Since the Conditions II.2 and II.1 do not depend directly on the number of sellers, they can be combined with Condition II.5 to determine the limiting equilibrium for the Binary-offers case of the *RCM*. I summarize the results below, where the characterization includes any possible value of the enforcement boundary L .

Theorem II.4: *Suppose that $(q^*, e^*, p^*)_{n=2}^\infty$ is a convergent sequence of equilibria with reading. Let:*

$$L^* \equiv \frac{\bar{e}(H-1)}{1-\bar{e}}.$$

If $L < L^$, then $(q^*, e^*, p^*)_{n=2}^\infty$ converges to the limiting equilibrium $(\tilde{q}, \tilde{e}, \tilde{p})$ defined by the equations:*

$$i) \tilde{q} = \frac{H}{H-L};$$

$$ii) \tilde{e} = \bar{e};$$

$$iii) \tilde{p} = \frac{\bar{e}(1-H)}{L(\bar{e}-1)}.$$

If $L = L^$, then the limiting equilibrium is defined by:*

$$i) \tilde{q} = \frac{H(1-\bar{e})}{H(1-\bar{e})+(1-H)\bar{e}};$$

$$ii) \tilde{e} = \bar{e};$$

$$iii) \tilde{p} = 1.$$

Finally, if $L > L^$, then the limiting equilibrium is defined by:*

- i) $\tilde{q} = \frac{c'(\tilde{e})}{H-L}$;
- ii) $\tilde{e} = \frac{(1-\tilde{q})(H-L)}{1-H+(1-\tilde{q})(H-L)}$;
- iii) $\tilde{p} = 1$.

Again, the proper interpretation of the limiting equilibria with reading identified in Theorem II.4 is that it must approximately equal the actual strategy profiles that make up any convergent sequence of equilibria with reading. Therefore, for an arbitrarily desired level of precision, we can find a number of sellers large enough so that corresponding actual equilibrium with reading in the sequence is approximated, with appropriate precision by the equilibrium with reading.

As the theorem demonstrates, there is always a unique limiting equilibrium with reading, regardless of the value of L . Whether the equilibrium with reading is a boundary equilibrium or an interior equilibrium is determined by the lower limit on enforceable offers. Theorem II.4 reveals the critical value $L^* < 0$ above which only a boundary equilibrium exists and below which only an interior equilibrium exists.

Theorem II.4 leads, additionally, to monotonicity results that demonstrate how the limiting equilibrium strategy profiles depend on the important institutional factors L and the buyer's reading cost function, c . The first result is on monotone comparative statics of the players' strategies in limiting equilibria of the Binary-Offers case.

Corollary II.3: *Suppose (q, e, p) is the limiting equilibrium with reading when the lower offer is L and that $(\tilde{q}, \tilde{e}, \tilde{p})$ is the limiting equilibrium with reading when the low offer is \tilde{L} , where $L \geq \tilde{L}$. Then $e \leq \tilde{e}$, $q \leq \tilde{q}$, and $p \geq \tilde{p}$.*

The essential features of the proof of this corollary are easy to understand. When L is increased, for any strategy q that the sellers may all choose, the marginal benefit to B of investing to read all offers instead of accepting without reading must be reduced. Consequently, B will invest less to read. Also, B has less of a motive to be cautious, to avoid accepting a low offer.

Theorem II.4 also leads to a natural corollary that relates the welfare (expected joint surplus) properties of the limiting equilibrium to the lower limit on enforceable offers. To compute the expected joint surplus associated with any strategy profile in Σ , first, let ϕ be the probability that at least one seller's offer is not negative if the sellers choose strategy $m \in M$. That is:

$$\phi(m) \equiv \Pr\{\max\{x_1, \dots, x_n\} \geq 0 | x_i \sim m \text{ for } i=1, \dots, n\}.$$

Of course, ϕ is also the probability B accepts after reading.

Next, let π represent the probability that the buyer accepts some seller's offer if the players use some strategy profile $(m, e, p) \in \Sigma$:

$$\pi(m, e, p) \equiv e \cdot \phi(m) + (1 - e) \cdot p.$$

Finally, let w denote total welfare:

$$w(m, e, p) \equiv \pi(m, e, p) - c(e).$$

Since each contractual interaction produces one unit of surplus, total welfare equals the probability that the buyer accepts some contract minus B 's reading investment. Notice that this notation suppresses the fact that the probability of agreement and total expected social surplus depend on the key institutional variable L .

The following corollary relates the expected social surplus associated with the limiting equilibrium with reading to the value of the low offer in the Binary-Offers case. I let $w(L)$ denote total welfare in the equilibrium with reading when the lower limit on offers is L .¹²

Corollary II.4: *If $L \geq \tilde{L}$, then $w(L) \geq w(\tilde{L})$.*

In Section II.F, I connect this monotonicity result on the low value offer with pre-existing institutional rules on enforcement of privately stipulated penalties. Restricting, ex ante, or reducing, ex post, the enforcement of damages which private parties can write into contracts can be taken to represent an active effort

¹²Section II.H contains results on the relationship between expected joint surplus of no-reading equilibria and the lower limit on offers, for each of the specifications of my model.

on the part of the courts to control the possible contract offers that parties may receive. I also describe how the doctrine of substantive unconscionability has a hand in determine the actual enforcement boundary of payoffs that players may get via contracting. Corollary II.4 consequently identifies the possibility that such rules may be justified on an efficiency basis.

Next, I state a result that highlights how the buyer's reading cost function affects the nature of the limiting equilibrium with reading. Again, the corollary extends directly from the basic characterization of limiting equilibrium in the Binary-Offers case.

Corollary II.5: *Suppose c and \tilde{c} are such that $c'(\epsilon) \leq \tilde{c}'(\epsilon)$ for every $\epsilon \in [0, 1]$. If (q, e, p) is the equilibrium with reading when B 's reading cost function is c , and if $(\tilde{q}, \tilde{e}, \tilde{p})$ is the equilibrium with reading when B 's reading cost function is \tilde{c} , then (a) $e \geq \tilde{e}$, (b) $q \geq \tilde{q}$, and $p \geq \tilde{p}$.*

This result shows that when B 's reading costs are relatively low, in an environment with many sellers, B reads the seller's offers with high probability and the sellers are relatively likely to offer B the contract H . Indeed, the sellers are induced to improve their offers to compete, and the buyer is also, then, willing to accept with high probability even without reading the offers. Summarizing, this must mean that total expected social surplus is relatively high in the limiting equilibrium with reading when the buyer's reading costs are relatively low.

Therefore, this comparative statics theorem leads to another corollary that relates expected surplus in the limiting equilibrium with reading directly to B 's reading cost function. To facilitate the presentation, I make explicit that the function $w(\cdot)$, operates on the set of reading cost functions satisfying Assumption 1.

Corollary II.6: *Suppose c and \tilde{c} are such that $c'(e) \leq \tilde{c}'(e)$ for every e . Then $w(c) \geq w(\tilde{c})$.*

This concludes my treatment of the Binary-Offers case. In the next section, I

discuss various features of real world institutions that address the key points which my results underscore. I also connect the contracting model with reading costs, and its implications, to existing literature.

II.F Institutional Connections and Reading Technology

As the results of Sections II.D and II.E make clear, when reading costs exist, limits on enforcement of contract offers are key determinants of efficiency in contract formation. This necessity of contract constraints echoes the basic logic of the Coase Theorem. [13] provides a wonderfully digestible account. If there were no negotiation costs—if the buyer had no reading costs—bargainers would prefer no rule limiting offers. And, the presence of negotiation costs implies court intervention is necessary for agreement. [3] test whether the Coase Theorem is robust to the introduction of bargaining costs, studying an alternating offers bargaining game in which the players must each pay a participation cost to be able to negotiate in any particular round.

Equilibrium analysis of the *RCM* establishes that contract formation generally depends on two important institutional factors which are the buyer's reading cost function and the lower limit on the buyer's possible payoff in any enforceable contract. Next, I discuss in detail how the subsequent comparative statics results obtained are helpful for understanding various ways in which contract enforcement may be designed or modified to improve efficiency of contract outcomes. In Subsection II.F.1, I argue that disclosure regulation and the formation defense of procedural unconscionability both have the effect of reducing reading costs. Then, in Subsection II.F.2, **penalty nonenforcement** and the performance excuse of **substantive unconscionability** are shown to help limit the range of possible contract payoffs that a player may receive from an enforceable contract; in other words, both doctrines factor into the definition of the *enforcement boundary*, represented in the *RCM* by the parameter L . And finally, in Subsection II.F.3, I

review various existing perspectives on what I call the *technology of reading*, and I argue generally that reading costs are of economically significant magnitude.

To conjecture about extending the scope or coverage of the commentary and analysis of the economics of contract enforcement which follows, consider briefly beforehand how the set of all formation defenses and performance excuses which the courts uphold (even stochastically) will effect reading costs and the range of possible contract payoffs, given the predictions for contracting behavior produced by my characterization of the set sequential equilibria with reading in the *RCM*. For instance, advocacy for enforcing a promise in a case of unilateral mistake might need to be rethought, (the standard efficiency-based argument for which is given coherently, and, ostensibly soundly, in [15], for example) if such a rule has both the effect of increasing reading costs as well as no effect on the lower limit on contract payoffs.

II.F.1 Disclosure Regulation and Procedural Unconscionability Affect Reading Costs

In Sections II.D and II.E, I use my characterization of equilibrium with reading in the limiting case of a large number of sellers to develop a monotonicity result which states that situations in which buyers face low marginal costs of reading correspond to equilibria with reading which have desirable efficiency properties. In such situations, the buyer reads with relatively high probability. This induces the sellers to improve their offers, to compete, which, in turn, causes the buyer to accept an offer with high probability even when the reading investment is not successful. The total reading cost the buyer incurs in equilibrium is necessarily lower, the lower is the incremental cost of reading. Hence, welfare must be relatively high in the equilibrium with reading when incremental reading costs are low.

These comparative statics results, for the general case and for the Binary-Offers case, on the buyer's reading costs in my model are connected directly to

courts' decisions about how best to interpret contracts. [50] argue that firms involved in supplier relations face added contract-writing costs when courts expand their interpretive role in adjudication, since it is harder for parties to predict how their contract will affect later outcomes. However, [50] recognize the important role of interpretation to establish legitimacy of contract formation in situations where at least one party is an individual, or "natural person." Related as well is the insight of [46] that courts can help to counteract the problems for contract formation that contract-reading costs may pose by refusing to enforce "misleading" modifications to standard form contracts that merely redistribute value, while upholding "sincere" modifications that actually create joint value. Of course, this is a call to expand the court's interpretive role.

Furthermore, disclosure regulations are typically aimed at making transparent certain important aspects of a (usually standardized) proposed economic deal. This translates into a reduction in reading costs faced by the party that has not made the proposal. For example, "truth-in-lending" regulations ensure that it is relatively easy for a potential borrower to compute the amount of interest that must be paid over the life of the loan. As another example, the Moss-Magnussen Warranty Improvement Act requires straightforward disclosure of important aspects of warranties; see for example [63]. Finally, we may interpret political proposals to establish official languages of contracting (for example a proposal to make English the official language of contract in the United States) in terms of the effect on reading costs and contract efficiency. Clearly, such a proposal will increase the reading costs that parties face if they are not **fluent** English speakers, and this will have a detrimental effect on the possibility of these parties forming contractual relationships efficiently in areas governed by the rule.

Finally, I address the formation defense of *procedural unconscionability*. This defense permits a party to have a contract voided (not enforced) if it can be shown that the process of contract formation was made intentionally misleading or unclear by a different party. As [6] explain, use of the (substantive) unconscionabil-

ity doctrine was bolstered by the creation of the Uniform Commercial Code, and procedural unconscionability in practice is used as one of the most common underpinnings of the unconscionability defense. Here is a statement of the basic unconscionability doctrine which, as [15] explain, reveals that the two separate notions of unconscionability are clearly mixed together in the official statutes—and presumably in practice, too:

Restatement (Second) of Contracts, Section 208 (1979): “Overall imbalance. Inadequacy of consideration does not of itself invalidate a bargain, but gross disparity in the values exchanged may be an important factor in a determination that a contract is unconscionable ... Such a disparity may also corroborate indications of defects in the bargaining process. ... gross inequality of bargaining power, together with terms unreasonably favorable to the stronger party, may confirm indications that the transaction involved elements of deception or compulsion, or may show that the weaker party had no meaningful choice, nor real alternative, and hence did not in fact assent or appear to assent to the unfair terms.”

This current use in U.S. contract law of procedural unconscionability in conjunction with substantive unconscionability is not necessary, though. And one of the attractive features of the *RCM* is that the theoretical framework provides a convenient and coherent, a cogent, decomposition of the equilibrium effects of the two separate unconscionability defenses, because procedural unconscionability reduces reading costs, only, while substantive unconscionability affects the enforcement-defined contract-payoff boundary, only. If the courts use procedural unconscionability, then sellers writing standard form contracts will have less of an incentive to use murky, unclear, or outright misleading language when interacting with an interested buyer, or even to lie by omission, and this will have the effect of reducing the buyer’s reading costs. However, my analysis of no-reading equilibrium in the *RCM* reveals that reading costs are only incurred in situations of simultaneous competition, which means that procedural unconscionability is not necessary (will not affect efficiency in the market) when such competition is absent.¹³

¹³See Chapter III for more details.

In fact, I argue it is possible and appropriate to require maintenance of an exact logical isomorphism between the applications of the two unconscionability doctrines, in the following sense. As I explain in Section II.F.2, analysis of equilibrium contracting behavior in the *RCM* suggests that the attractive feature of the substantive unconscionability doctrine is its guarantee of an enforcement boundary on (low) contract payoffs, and not necessarily at all that it ensures fairness. Therefore, to create and justify the isomorphism, consider that the attractive feature of the procedural unconscionability doctrine, it follows, must be not just that it demarcates contractual *processes* into those that are, and then, also, those that are not, deemed conscionable and as a result enforceable, but, moreover, that the essential feature of procedural unconscionability, as an implication, is the determination of a boundary on the reading costs.

My paper is closely related to that of [46] who studies contract-reading costs associated with additional terms in standard form contracts. [46] reaches the conclusion that courts should step in to void “misleading” modifications to standard form agreements. [31] also models reading costs which a buyer faces when confronted with a seller’s standard form contract. [31] determines that court mandated implied warranties are Pareto-superior to policies such as the *duty to read*, which makes a buyer responsible for reading fine print in a seller’s contract, and the *duty to speak*, which put the onus on the sellers to explain terms to buyers. Of course, courts, to establish that particular terms are indeed “misleading” or “sincere” must play an active role in interpreting contracts. [53] argues that it is in the mutual interest of parties to a contract (in the majority of cases) that the court reinterprets their agreement, at least given some contingencies that may be costly to describe.

There are also reasons that suggest courts should not intervene to interpret parties’ private contracts beyond literal content. [50] make the point that interpretive rules impose costs on parties to a contract, making it more difficult for parties to relate their written contract to the likely outcomes of adjudication.

Also, these authors argue that courts, to encourage efficient relationship-specific investment, should allow parties explicitly to restrict the court's interpretive role in adjudication via their initial contract. This serves the purpose of reducing initial contract-writing costs and permitting parties to control, at least partially, the costs of renegotiation.

It is also important to admit that one of the faults of the *RCM* and the analysis I have presented is that I have chosen to gloss over the interrelationships that exists among the various processes of contract formation and the subsequent **real contingencies** that make up the fibers of a universe that operates, for the most part, typically independently of what the parties have decided to attempt to do as stated and planned in the final contract. Consequently, I ignore the dichotomy that always is present in actual contractual situations: some contingencies, or, no less precisely, some aspects of extant states of the world, are contract-controlled, but the vast majority are not contract-controlled; many call for responsiveness to a certain externally determined stimulus. For example, suppose that *B* has accepted a contract that states she, “will prevent it from snowing anywhere in New York, New York, on Valentine’s Day, 2010, or will pay *S* the amount of 75.” The enforcement of this term, when it snows, would be equivalent to the enforcement of the similar term, “*B* will pay *S* the amount of 75 if it snows anywhere in New York, New York on Valentine’s Day, 2010.” It snowed, and so *B* apparently must expect that she owes the money. However, the enforcer would need to determine that the latter of these terms describes responsiveness, but that the former term has *B* doing something that seems impossible, namely, preventing it from snowing (provided *B* has not just come up with some important discovery and does not have in mind that for whatever reason, “There isn’t going to be a ‘New York, New York’ in 2010”). We would have to ask, further, whether *B* would always have to pay 75 using the former term, anyway, since, even if it did not snow, it would be true that *B* had not prevented it from snowing.

II.F.2 The Penalty Doctrine and Substantive Unconscionability Limit Contract Payoffs

Really, the only way that a particular damage (which is a court-compelled, and always finite, *financial transfer* from the holdings of the breaching agent to the holdings of the breached-against agent) in a contingency ever could even be larger under an enforcement system that employs the penalty doctrine according to some probability distribution than under an otherwise equivalent enforcement system not using the penalty doctrine, or using it, but only according to some alternative distribution under which this use would occur universally with a lower frequency, would be if the equilibria of the two systems forced this to occur, for some other reason, given the probability distribution over possible menus of contracts (or other unrelated contractual devices and mechanisms, stochastically) that various potential parties may have considered ending up writing with a certain likelihood and also conceivably accepting, again with a certain given, but generically different, likelihood. Logically, this possibility does not exist in the *RCM*, as I have defined the contact and interaction during contract formation, because I study a situation in which L , the lower limit on enforceable offers, varies to affect the possible splits of surplus that might be arranged by S and then agreed to by B , but does not vary to affect the size of surplus, itself.

Penalties, court-compelled financial transfers with a magnitude that exceeds harm, may be used, it is well-known, as a contractual device by two or more parties in an effort to help to distribute risk, and I have assumed the players are risk-neutral. [15] discuss this possibility, and [45] provides a compelling, straightforward numerical example. This type of flexibility, using freedom of contract to shift risk presumably to the least-cost risk-bearer, will be important for achieving efficient contractual outcomes especially when the parties' attitudes toward risk are very different and at least one party is not very-risk averse. Otherwise, it is not clear that the impact on efficiency will be any more substantial than that of reading costs or payoff limitations on contracts.

In common law countries, courts enforce the penalty doctrine, which says that privately stipulated damages (liquidated damages) and breach remedies cannot be punitive. By contrast, in civil law countries, privately stipulated damages are allowed to exceed the harm caused to the innocent by the party who has breached, *though frequently the magnitude of the privately stipulated punitive measure is reduced in court*. [17] use the distinction between the common law and civil law traditions to instrument for procedural formalism in dispute resolution in 109 Lex Mundi countries. [17] establish a causal link between procedural formalism and inefficiency and corruption of the legal system. However, [59] describes the detailed, noisy process that the courts in common law countries go through in order to assess appropriate damages. Indeed, to make an accurate comparison of the real limits on offers that are enforced in various countries, it is necessary to demonstrate that the distinction between enforcement and nonenforcement of penalties is not nearly nominal in nature.

On the surface, a doctrine of nonenforcement of privately stipulated penalties seems inappropriate from the point of view of neoclassical economics. Why would anyone potentially affected by a contract want restrictions on contract choice? [49] argues that the legal prohibition against contract terms that require parties to use bankruptcy procedures other than that supplied by the state must be inefficient, because such a prohibition discourages efficient relationship-specific investment. [62] argues that there are real technological limitations on the extent to which courts can force particular outcomes. [62] determines that parties can write options on inalienable decisions, those which courts cannot compel, and that this widens the scope of implementability. [57] examines the incentive effects of various liability rules in environments where information is partially verifiable to the court, and concludes that situations exist in which parties may negotiate contracts that specify excessive (punitive) liquidated damages as a commitment device. [40] studies labor contracting as an entry game without renegotiation, and reaches a similar conclusion. [56] show that court interference with privately stip-

ulated damages cannot be justified on the grounds of inefficient barriers to entry when potential entrants price competitively (and so will make zero profits). Hence, there are many different arguments in the law and economics and contract theory literatures which suggest that permitting parties to specify privately stipulated punitive damages (penalties) is actually socially optimal. Indeed, [21] make the argument that allowing parties to write contracts with punitive liquidated damages terms serves two key economic functions. First, such damages provide insurance for the innocent party, who may have a high subjective evaluation of performance. Second, offering to pay punitive damages in the event of breach may permit the promisor to signal private information, for instance about the prospects to repay a debt; so privately stipulated penalties may circumvent to some extent problems of asymmetric information. The results of this paper on monotonicity in the lower limit, L , of welfare associated with the reading equilibrium suggest that this line of reasoning could need modification.

There are already several responses that suggest that restrictions on penalties actually may be justifiable from an efficiency standpoint. The existing arguments appeal to considerations of externalities, asymmetric information, renegotiation, or indescribability of contingencies. In [56], for instance, parties involved in a supply contract specify punitive damages to erect a barrier to entry, and this creates a negative externality whenever the entrant has some market power. [56] show that court imposed restrictions on damages eliminate the externality and are Pareto-improving. [1] and [28] analyze a situation where entrepreneurs who have private information about their potential for success must take on debt to finance their projects. The entrepreneurs who have private information about their possible success must take on debt to finance their projects. The entrepreneurs who expect their projects to succeed may promise to pay excessive damages in the event of failure, to signal confidence to lenders. [1] and [28] both argue that restricting penalties of this type can rule out such a signalling equilibrium, and may be Pareto-Improving when entrepreneurs are sufficiently risk averse. [59] uses

mechanism-design analysis and shows penalty nonenforcement discourages strategic behavior, and raises welfare, in renegotiation games that take place under asymmetric information. Additionally, [4] demonstrate that courts may want to void (with positive probability) contracts that specify transfers in contingencies known to be “indescribable” at the time of contract formation. Raising the probability with which a contract will be voided in an indescribable state provides insurance against such states, but this comes at the expense of a reduction the parties’ incentives to make efficient relationship-specific investments. So, my paper contributes to the literature which argues for court constraints on private contracts by introducing the consideration of reading costs and also by demonstrating that reading costs represent an additional reason for courts to control enforcement of contracts.

Next, I will briefly discuss whether the performance excuse of *substantive unconscionability* has an impact on the range of possible payoffs that may obtain for a given party in a contract that is enforced. It does. Finally, notice that the use of substantive unconscionability doctrine by courts in common law countries, and, likewise, the use of lesion as a performance excuse by courts in civil law countries, represents a demarcation of the set of enforceable contracts: there are those that are (and then also there are those that are not) deemed *conscionable*, and, consequently, enforceable. In the *RCM* it is appropriate to consider these activities and doctrines as determinants of the parameter L , because I associate substantive unconscionability with a low contracting payoff for B , and not with any precise notion of fairness in the division of surplus between B and the seller with whom she contracts.

II.F.3 Various Perspectives on the Existence, Economic Significance, and Technology of Reading

I next connect the *RCM* to other existing works in the literature associated with the technology of reading. There is a large and growing body of work on contract-writing costs, including [18], [55], [5], and [51]. In these papers, parties

to a contract jointly face costs associated with making contracts more complete, in the sense of specifying outcomes in extra contingencies. Clearly, if there is a substantial cost to including a contingency in a contract, parties will not want to do so whenever that contingency is sufficiently unlikely to occur. This means that contract-writing costs can help to explain the abundance of incomplete contracts that are observed in practice. [61] surveys the literature on incomplete contracts, but does not explicitly address the issue of contract-reading costs. Again, I emphasize that my contracting model with reading costs can have equilibria in which the buyer does not establish a productive relationship with certainty, which represents a type of contract incompleteness. In my model of contracting with reading costs, the buyer must make an individual, noncooperative, costly investment to trace out the implications of sellers' contracts, but the contracts are costless for sellers to write. The contracts that sellers write are also "complete" in a sense, since they cause full surplus in a relationship necessarily to be realized if accepted. However, if the enforcement boundary is defined so as to permit contracts that yield the buyer a payoff worse than that of the outside option, the buyer will not accept a contract with probability one, and, in this case, the model may be interpreted as one of contract incompleteness.

Obviously, in *RCM*, there is a fundamental asymmetry in the ability of the players to comprehend how communication with the court, via the contract, affects enforcement. The buyer must make an investment to be able to determine the possible impact of any contract proposed by any seller. [35] provide conditions under which one side of the relationship completely controls communication with the court, and hence authority arises endogenously. Similarly, [28] emphasize that their prescriptive points are directed toward situations in which both sides of a contractual relationships are **sophisticated**.

In the *RCM*, the buyer can invest to try to observe sellers' contract offers. Related is the model of espionage analyzed by [39]: players choose strategies in a repeated game, but, prior to implementation, there is a chance one's opponents will

try to spy, to find out what strategy one plans to play. [39] finds all the subgame perfect equilibria of any infinitely repeated game with espionage must be efficient. More recently, [54] show that, in games with espionage, the spying party can have a second-mover advantage.

The buyer's decision of whether to read is a form of costly information acquisition. [46] makes the point that the decision to pay a contract-reading cost is analogous to a government's decision about whether to audit tax returns. (Were auditing not costly, there would be no reason to audit, because nobody would be able to cheat.) [8] present a model of auditing and characterize Bayesian incentive-compatible auditing policies. The buyer's decision of whether to invest to read is also related to firms' decisions about whether to invest to learn about the capabilities of possible employees. [25] present a model of the labor market in which firms test workers to learn about unobservable abilities. The tests are costly to administer and are not always accurate.

The association of costs with the buyer's reading decision seems, perhaps, on the surface, to make the *RCM* a model of what the literature has called "bounded rationality." According to the classification of models of bounded rationality provided in [14], the *RCM* is a *deliberation* cost model, where I close the model with standard optimization. [14] ends up unambiguously as an advocate of deliberation cost models, and this is encouraging support for the basic framework of the *RCM*.

But it is important to be careful.

Contract reading, in reality, is costly, as has been described, but, is that the buyer's reading cost function, $c(e)$, may not be constant at zero in the *RCM*—indeed that is the point connecting, with the greatest strength, the *RCM* with observed reality—tantamount to a built in assumption of bounded rationality in decision-making on the part of the buyer, when she or he evaluates whether to invest to read a certain contract offer? The only correct answer to this question must be that the inclusion, in the *RCM*, of positive, and substantial, reading

costs *definitely is not*, in any way, essentially equivalent to some limitation of **rationality** in the buyer's decision-making process. Why is this? A quick and sound demonstration is that anyone with the belief that readers of contracts act *as if* they are rational, even if they in reality may not be rational, would also have to hold the belief that it is rational for contract readers to incur the costs of reading contracts, because contract reading must have either an associated opportunity cost or must require the purchase of the services of another. To unpack the assertion, and to provide greater detail, that the *RCM* is not a model of bounded rationality, however, it is necessary to start with an understanding of the usual *goal* of a contract reader in reality, the accurate description of which will then allow one to understand the necessity of the process and the rationality behind incursion of the associated costs; and indeed this is what prevents the *RCM* from being a model of bounded rationality in the first place. The contract reader's primary objective, in reading, is to determine the possible, the likely, payoff implications of the contract, which always will be available in some complete written format; the benefits to the buyer, in the *RCM*, of achieving this objective are represented by the value of reading, $v_B^r - v_B^{nr} \geq 0$.

It is encouraging, for example, that, Rasmusen is of the opinion, in [46], that contract-reading costs provide a foundation for work on incomplete contracts which improves upon previous notions of bounded rationality.

One way to interpret the representation of reading technology in the *RCM* is to imagine that *B*'s deliberation occurs at the level of deciding how much to invest to learn the language of the sellers' contracts, rather than at the level of deciding how much to invest to read the contents of any particular seller's offer. In other words, I focus on the case where there is *perfect complementarity* in the buyer's ability to read all of the contracts. I also assume that the buyer faces no fixed costs of reading, but, instead, incurs a variable cost associated with raising the probability with which she is successful at learning the language required to read all of the offers.

My model therefore differs with some other models of contract-writing costs, which assume essentially that including an additional term in a contract costs parties some fixed amount. [46] contends contract-reading costs provide a foundation for work on incomplete contracts which improves upon previous notions of bounded rationality. Also, [3] study an alternating-offers bargaining game, where the opportunity cost of responding to a bargaining partner’s proposal, to accept or to reject, and foregoing other productive activity in the process, is often substantial relative to the potential gains from trade. Finally, in [20], an entrepreneur must allocate limited attention between writing new contracts and updating already established contracts. This tradeoff can make simple, incomplete contracts optimal. The constraint on attention implies that the activity of contracting necessarily carries an opportunity cost.

Next, in an attempt to help justify assumptions about perfect complementarity of the reading technology, it helps to compare and contrast the following three sentences:

1. Buffalo buffalo Buffalo buffalo buffalo buffalo Buffalo buffalo.
2. Buffalo buffalo Buffalo buffalo buffalo also buffalo Buffalo buffalo.
3. Buffalo buffalo that Buffalo buffalo buffalo buffalo Buffalo buffalo.

Sentence 1 is, “a fiendish string devised by my student Annie Senghis,” taken from Steven J. Pinker’s book, *The Language Instinct*; [44].¹⁴ These sentences do not have any obvious economic significance beyond some imaginary situation—for example where the reader was required upon acceptance of a contract at some point

¹⁴Incidentally, in [44], Pinker, writing about the possibility of successfully programming computers to understand language, notes that, “But household robots are still confined to science fiction. The main lesson of thirty-five years of AI research is that the hard problems are easy and the easy problems are hard;” and later that understanding, “a sentence is one of (the) hard easy problems.” Pinker probably only means that some of the hard problems are easy for computers to solve (for example, just try and program a computer that can disprove the existence of God—and how would you know that you had done it?—this is a hard hard problem) but Pinker’s point is sharp as it pertains to the right ideas about the *RCM*: *B* will not be able to buy software to solve the reading problem; and I am not just discussing this issue on some meta-level of *B*’s attempts to read the software contract that has to be introduced to the problem (or that *B* somehow, “will not be able to get away without reading something else”), because I literally mean that producing such software would be infinitely costly, if humans do not have the requisite exciting breakthrough in AI and computing that really might not ever even happen.

after a particular contingency to explain to a third party the basic meaning of one of the “Buffalo buffalo” sentences, in isolation, or to pay a fine, and further that this somehow might benefit the three parties by allowing them to share risk in a particularly intricate fashion—and, it subsequently does not seem that any of the three could be usefully written into a contract in a way that permits the affected parties to create substantial joint value. Additionally, it is not possible to imagine a reasonable situation in which parties involved in a productive relationship would be able to write a contract using any of these “Buffalo buffalo” sentences that induced an efficient outcome (an efficient trade for instance) but would not have induced an efficient outcome in the parties’ relationship if the “Buffalo buffalo” sentence were not included. This on its own is a very interesting issue; what examples of sentences, phrases, or the use of language by humans exist that are ever *necessary* for the user effectively and efficiently to communicate a desired point? But for an appeal to art, such as, “Not starting with, ‘Call me Ishmael.’ would have had to reduce the economic value, demand for, and market share of *Moby Dick*,” or a similar appeal to revelations, it is difficult to think of any use of language that is necessary in this sense.¹⁵ Also, *homo economicus* would, when watching [64], undoubtedly think to herself that Gutman is being entertaining, precise and somewhat sophisticated, but also merely providing a symbolic representation of truth about the world, when he says, calmly, “Yes, the most dangerous word in any human tongue is the word for brother. It’s inflammatory.—I don’t suppose it can be struck out of the language altogether but it must be reserved for strictly private usage in back of soundproof walls. Otherwise it disturbs the population”

Therefore, the *necessity test* is too strong for *homo economicus* to use in every situation to try to reject an analysis of the various reading costs associated with these “Buffalo buffalo” sentences. In fact, since no economic language used in contract would be necessary in this sense, we may push this idea further and turn

¹⁵Certainly, examples of destructive and damaging language also exist which may satisfy the necessity test. But, a full and proper treatment of the subject is beyond the scope of a work not directed at determining the validity of the test.

it into an argument for the viewpoint that the “Buffalo buffalo” sentence must be as good as any other particular candidate, by the necessity test, for exactly this type of impressionistic analysis of the real technology of reading. Another example illustrating the value of the analysis is that of a STOP sign and specifically its use of just “stop,” rather than any alternative phrase, such as, “stop your vehicle,” which would be roughly and perhaps exactly equivalent: an approaching motorist, most of the time, would just see a red sign with white lettering and identify it as a “STOP YOUR VEHICLE sign,” and behave accordingly, perhaps even stopping the vehicle¹⁶

So, despite their doubtful direct economic significance, compared to an entire car rental contract for example, we can use the “Buffalo buffalo” sentences to explore our intuition about reading costs that players in contract games like the *RCM* face. Remember that I have defined the variable e to represent the *probability* with which B is able to understand the language in each seller’s offer. Presumably, a reader that understands one of the sentences will also understand the other sentences, and, using this argument, it seems we should conclude that Sentence 1—the shortest of the three—must have the lowest reading cost; indeed this is most likely valid unless we do not ignore that there are substantial differences in the ease with which the typical reader (or literally any human English speaker in the world) will arrive at an understanding of any of the three sentences in isolation. What process does the reader use to come to an understanding of one of the “Buffalo buffalo” sentences? Without explicitly doing some rigorous linguistic comparison of the trio to determine an answer, or, what would be better, providing

¹⁶Nevertheless, one could be forgiven for finding something appealing about weakening the necessity test and using it to convey the notion that in real life certain communications will be important or made with great care while others will be insignificant. Furthermore, to the extent that any particular usage of language is deemed important, we should expect that it closely approaches satisfying the necessity test. Look. If I just want to buy a sandwich, maybe, or a cup of coffee, there must be a more than a million different ways that I can describe the exact amount of mayonnaise I would most prefer, or whether I want a lump of sugar, but if I am naming the educational institution that I have just created and financed, I might care if I get to use a particular name such as, “the Oprah Winfrey Leadership Academy”. Still, suppose I decided I wanted to use this title, but it was then somehow determined that this meant I could not legally operate the leadership academy. I believe I would change the name instead of closing down the school and even without paying any requisite substantial fines; I would most likely just back off and pick something else, some legal and acceptable name.

a complete and comprehensible full physical model of the make-up of the mind, we can appeal to the intuition of *homo economicus* to conclude that in fact Sentence 1 must have the highest reading costs. Also, it is not obvious at *homo economicus*'s first glance whether Sentence 2 has higher or lower reading costs than does Sentence 3, for any given level of the reading probability, though presumably these costs are considerably closer to each other than they are to the reading costs associated with Sentence 1 (where, again, remember I mean the opportunity cost of time spent reading one of the sentences in isolation, in an attempt to understand its possible meanings, and without any prior knowledge about the “Buffalo buffalo” sentences that we might even sometimes have expected *homo economicus* to acquire somehow, either because it is in the general knowledge of anybody operating in the market that houses economic interaction, or because *homo economicus* has a type of **license** that suggests a particular capacity to play the game appropriately, or, finally, for some other potentially imaginary and unimportant reason). Personally, I believe that Sentence 3 has the lowest reading costs of the trio.

Next, consider the following two additional “Buffalo buffalo” sentences.

4. Buffalo buffalo that Buffalo buffalo buffalo also buffalo Buffalo buffalo.

N. ... Buffalo ... buffalo ... that ... Buffalo ... buffalo ... buffalo ... also ... buffalo
... Buffalo ... buffalo

Pinker almost provides us with an example of Sentence N and definitely a move in the direction of reducing *his* readers' costs of understanding Sentence 1: “(The) Buffalo buffalo (that) Buffalo buffalo (often) buffalo (in turn) buffalo (other) Buffalo buffalo.” Of course, being overly careful, one could note that the word “often” in Pinker's example of Sentence N, does change the meaning of the sentence slightly; “often” is not merely used as a clarifying word; it does not simply catalyze the reader's understanding of the basic meaning of the “Buffalo buffalo” sentences, because now we know for example that these types of events are apparently not extremely rare. Comparing the reading costs of Sentence 4 with those of Sentences

2 and 3, we see that a trade-off exists; Sentence 4 is longer, but also somewhat clearer than either 2 or 3. Clearly, Sentence N could be made long enough, with the addition of too many “clarifying” words, used in the manner that I have used the words “that” and “also” in Sentence 4, so that in the end Sentence N would unambiguously have higher reading costs than even Sentence 1 would have. We can utilize the “Buffalo buffalo” sentences, Sentences 1-4 and N, and my assertions about *homo economicus*’s independent reading to understand them, to create a strong metaphor for the process of **comparison-shopping**, as in [63], that individual buyers in the real world are continually using to evaluate consumer sales contracts, such as private insurance, credit or debt contracts, rental agreements, and many others. This important metaphor then continues on naturally to facilitate an evaluation of my analysis of the *RCM* and its economic relevance, where it can be unpacked to permit me justify the assumption that *B* either understands exactly all of the sellers contracts or does not succeed in obtaining an exact understanding of any of contracts and instead is put in a situation where she must evaluate the sellers’ offers individually given beliefs about what they are likely to have offered her: either *homo economicus* understands one of the “Buffalo buffalo” sentences, 1-4, or *homo economicus* does not understand any of the quartet. Notice, however, that a specification of Sentence N clearly must exist that could not be understood at zero cost to any individual person without prior knowledge of it but with prior knowledge of any subset of Sentences 1-4. And so therefore apparently the “Buffalo buffalo” sentences are also able aptly to illustrate the fact that the assumption of perfect complementarity of the reading technology is *never* going to be perfectly valid—and actually it is admittedly always “not valid”—for the real complex contracting cases that are the stuff of substantial economic reading costs like those associated with requests for proposals that are sent out during for instance the procurement processes of many currently existing as well as former and future governmental and privately operated institutions.

From a modeling standpoint, it is possible to extend the basic *RCM*

to generalize the reading cost function and the reading investment itself, letting $e = (e_1, e_2, \dots, e_n)$ represent a vector of reading efforts, one for each of the n sellers, and then letting $c(e)$ represent the costs associated with these reading investments, where $c(e)$ is a vector-valued function that reports pecuniary and non-pecuniary costs alike.

Then, simplify so that $c(e)$ reports only a single cost measured in the same units as B 's contract payoff x and we could look at the equilibrium condition which would have B equating the marginal cost of reading a particular seller's contract with its marginal benefit, where the marginal benefit is the increase in expected payoff from contracting, given that B now reads that seller's contract with a higher probability.

How does the specification of the reading probability, p , change? Suppose that B reads the contracts of sellers $1, 2, \dots, m$, where $m < n$, and suppose that $L < 0$. If the sellers use mixed offer distributions with the same structure as those specified in Condition II.3, the buyer will end up, with positive probability, rejecting all m offers, because they all happen to promise L , but still accepting an offer from one of the $n - m$ sellers whose contracts he has not read.¹⁷ So, p_η would represent the probability that B accepts an unread contract after reading the contracts of the sellers in the subset of sellers η . In equilibrium, any particular p_η would be interior only if $v_B^{nr} = 0$, assuming the sellers use symmetric strategies, and the structure of Condition II.1 is retained.

Finally, we would need to alter Condition II.3 to reflect the change in B 's reading technology and to show the same type of mixed distribution is supported (this is necessary for B to want to read).

II.G Conclusion

I have shown that the *RCM* relates two significant features of real world contract formation. Specifically, the presence of substantial reading costs on the

¹⁷Read 'em and weep! That might seem ironic were it not for the lessons of Theorem II.1.

part of the buyer implies a role for restrictions on the enforcement of private contracts. This insight accords with pre-existing institutional rules observed in practice, such as unconscionability laws and the penalty doctrine used by the courts in common law countries, or the tendency of the courts in civil law countries to reduce privately-stipulated punitive measures. One important qualification of my monotonicity result on welfare with respect to the lower limit on enforcement of offers is that real world contractual relationships are heterogeneous. Rules appropriate for one type of contractual relationship prove poor for different types. Specifically, certain parties may want to write contracts specifying large transfers in certain contingencies, if they would like to share risk, for instance. The key concern is to what extent this heterogeneity will be verifiable to the court. If important information about “relationship types” is not verifiable, the basic message of Corollary II.4 must be modified because increasing the mandatory payoff to one party may cause another party to avoid interaction. However, the point of Corollary II.6 that reducing the buyer’s reading costs must lead to an increase in expected joint surplus, will carry over to the more general case of heterogeneous buyers, since it is always desirable to have buyers read contracts with high probability and at low cost. This consideration is addressed effectively, for the bilateral monopoly (single-seller) case, in Chapter III, where two-sided asymmetric information existing between a buyer and seller generates heterogeneous relationships that must be governed by uniform enforcement rules.

II.H Appendix: Monopoly and No-Reading Equilibrium in General

In this paper, I study a particular cooperative transformation of the single-seller game. [42] outlines a standard program in which a game with only dismal equilibrium outcomes is transformed to one in which cooperative equilibrium outcomes exist. Any combination of repetition, communication, or enforcement

can affect the transformation. In this appendix, I show that the single-seller case of my model of contract formation with reading costs only has no-reading equilibria. Also, if the lower limit on enforceable offers is worse for the buyer than the outside option, the only equilibrium is a “dismal” no-reading one. There are two different ways that equilibria in which a contract is accepted with positive probability will emerge.

First, even in the pure monopoly case, where there is only one seller making an offer to the buyer, as long as the lower limit on enforceable offers is at least as good for the buyer as is the outside option, the buyer will accept the seller’s offer without needing to read it. Second, if there is simultaneous competition present, as I have assumed throughout the main text of Chapter II, then an equilibrium with reading exists in which the buyer accepts some contract with positive probability even if the lower limit on offers is arbitrarily bad for the buyer.

In a model that shares many of the same features of my model, [3] identify a hold-up problem in contract negotiation that arises from “participation” costs. [3] analyze an alternating-offers bargaining game with complete information, where in every period, both the proposer and the responder must pay a negotiation cost to participate. Importantly, my model differs from that of [3] since I assume that an agreement may be reached even if reading costs are not incurred. The mechanism is that the buyer will accept some seller’s offer, even without investing to read it, provided the offer is not anticipated to be worse than the buyer’s outside option. In [3], by contrast, if one’s bargaining partner does not pay a negotiation cost in some period, then no offer can possibly be made, and negotiation is delayed. Despite the discrepancy, both models do generate hold-up type results, in the spirit of [33].

The first result characterizes the set of sequential equilibria in the monopoly case of the reading costs model, or the *MRCM*. Specifically, there exist only no-reading equilibria. The second result is a corollary on the expected social surplus associated with the no-reading equilibria of the *MRCM*. In this appendix, I make

the following assumption on B 's reading cost function. (Notice that it is weaker than Assumption II.1.)

Assumption II.0: $c(\cdot)$ is differentiable, with $c(0) = 0$ and $c(\cdot) > 0$.

Call the monopolist S . In the monopoly case, given a strategy (e, p) for B , any offer $x \in [L, 1]$ that S makes with positive probability must maximize:

$$(1 - x)[eI_x + (1 - e)p],$$

where I_x is the indicator function that equals 0 when $x < 0$ and equals 1 otherwise. By inspection of S 's maximization problem, we can state the following result.

Lemma II.0 *If (m^*, e^*, p^*) is a sequential equilibrium of the MRCM, then $x \in \text{supp}\{m^*\}$ only if $x \in \{L, 0\}$.*

As a consequence, we can see that in any sequential equilibrium of the MRCM, it must be the case that $v_B^{nr}(m^*) \leq z(L)$ and $v_B^{nr}(m^*) = z(L)$. By Condition II.2, therefore, arguing heuristically, any sequential equilibrium of the MRCM must be a no-reading equilibrium.

I next flesh out the details of this argument in the following theorem. Remember I use Γ to denote the set of sequential equilibria, and that Γ^{NR} represents the set of no-reading equilibria.

$$\mathbf{Theorem II.0:} \quad \Gamma = \Gamma^{NR} = \begin{cases} \{(m^*, 0, 1) | x = L\} & \text{if } L > 0 \\ \{(m^*, 0, p^*) | x = 0\} & \text{if } L = 0 \\ \{(m^*, 0, 0) | v_B^{nr} < 0\} & \text{if } L < 0 \end{cases} .$$

Proof: First, consider the case where $L > 0$. By Lemma II.0, S offers $x = L$ in any sequential equilibrium. Therefore, by Conditions II.1 and II.2, B must choose $e^* = 0$ and $p^* = 1$ in the unique sequential no-reading equilibrium for this case. The case $L = 0$ is identical, except that B might choose $p^* \in (0, 1)$ in a no-reading equilibrium by Condition II.1, since S offers $x = L$. Finally, suppose $L < 0$. By Lemma II.0, we know that $v_B^{nr}(m^*) \leq 0$ and that $v_B^{nr}(m^*) = 0$ in any sequential

equilibrium. Consequently, by Condition II.2, B must select $e^* = 0$. Now, since every sequential equilibrium in this case must be a no-reading equilibrium, we see in fact that S must choose to offer L instead of $x = 0$. And this implies that B must choose $p^* = 0$ by Condition II.1. *Q.E.D.*

As Theorem II.0 shows, in the *MRCM*, only no-reading equilibria exist; and, further, the lower limit on offers, L , which B may receive completely determines whether a productive contract is established. Said differently, when reading costs exist, contract formation leads to an efficient outcome only if there are restrictions on contract enforcement, otherwise a type of hold-up problem emerges. Of course, the reading investment is not a relationship-specific investment in the standard sense, because it does not affect joint surplus created in the partnership.

Theorem II.0 leads to the following result on the expected amount of surplus generated by interaction opportunity and the possibility of efficient contracting. Remember that for any strategy profile $(m, e, p) \in \Sigma$, $w(m, e, p)$ represents the magnitude of the expected joint surplus, where the extension of the functions $\pi(\cdot)$ and $w(\cdot)$ is straightforward for the *MRCM* case.

Corollary II.0: *Suppose (m^*, e^*, p^*) is a no-reading equilibrium of the MRCM. If $L > 0$, then $w(m^*, e^*, p^*) = 1$. If $L = 0$, then $w(m^*, e^*, p^*) \in [0, 1]$. Finally, if $L < 0$, then $w(m^*, e^*, p^*) = 0$.*

By Corollary II.0, when $L > 0$, every equilibrium of the monopoly case is efficient, in the sense that it maximizes the sum of the players' ex ante expected payoffs. So, when $L > 0$, the presence of the substantial reading costs, the static, ultimatum structure of the single-seller case, and the lack of competition do not at all hinder efficient negotiation. Redistribution might be another consideration, although the standard argument in the law and economics literature is that redistribution is most appropriately handled by a system of taxation and subsidization, rather than via the legal system; this argument appears as motivation for efficiency-based law and economic analysis, for instance, in both [15] and [45]. Therefore, from the current standard viewpoint of law and economics scholars, it seems from Corollary II.0

that there is no reason to prefer any particular $L > 0$ or $L = 0$, because the resulting no-reading equilibrium would be efficient anyway. When $L < 0$, however, the presence of reading costs makes it impossible to generate any surplus, and the conclusion is completely reversed. Hopefully, this result helps to highlight the fact that well-defined limits on contracting, enforcement boundaries, such as those induced by the penalty doctrine and even unconscionability (which is now motivated by considerations of fairness), are vital for achieving efficient outcomes when a monopoly exists.

Next, I extend this analysis to characterize no-reading equilibria in the Binary-Offers case of Section II.E. I show that the Binary-Offers case has a unique equilibrium no-reading equilibrium, for any $n \geq 2$ and any $L \leq 1$. I omit the proofs of this and the next result, because they are very similar to the proof of Theorem II.0.

Theorem II.5: *In the Binary-Offers case of the RCM, the set of no reading equilibria is:*

$$\Gamma^{NR}(L) = \begin{cases} (1, 0, 1) & \text{if } L > 0 \\ \{(1, 0, p) | p \in [0, 1]\} & \text{if } L = 0 \\ (1, 0, 0) & \text{if } L < 0 \end{cases} .$$

The next theorem says that a no-reading equilibrium of the RCM exists for any specification of n and $c(\cdot)$ and for any value of the enforcement boundary L .

Theorem II.6: *In the RCM,*

$$\Gamma^{NR}(L) = \begin{cases} \{(m^*, 0, 1) | x = L\} & \text{if } L > 0 \\ \{(m^*, 0, p) | x = 0 \text{ and } p \in [0, 1]\} & \text{if } L = 0 \\ \{(m^*, 0, 0) | v_B^{nr} < 0\} & \text{if } L < 0 \end{cases} .$$

In Section II.C, I define Γ and its subset Γ^{NR} so that they do not include asymmetric sequential equilibria. Observe that, when $L < 0$, there are sequential no-reading equilibria that are not symmetric. In any of these, each seller S_i uses a strategy m_i such that $v_B^{nr}(m_i) < 0$. Moreover, all of these asymmetric equilibria are payoff-equivalent to the symmetric equilibria that I identify.

This characterization of no-reading equilibrium leads directly to a corollary on the expected social surplus that associated with no-reading equilibrium in the general specification of the *RCM*. The analysis is straightforward for the case of no-reading equilibrium. For any number of sellers, and for any reading cost function satisfying Assumption II.1, Theorem II.6 of the no-reading equilibria in the model produces the following corollary about welfare.

Corollary II.7: *If $L > 0$ and $\sigma \in \Gamma^{NR}(L)$, then $w(\sigma) = 1$. If $L = 0$ and $\sigma \in \Gamma^{NR}(L)$, then $w(\sigma)$ can take any value in $[0, 1]$. Finally, if $L < 0$ and $\sigma \in \Gamma^{NR}(L)$, then $w(\sigma) = 0$.*

II.I Appendix: Proofs

This appendix contains proofs of the lemmas and theorems stated in Sections II.D and II.E.

Lemma II.1: *If $\theta \geq \psi$, then $m^*(\psi)$ first-order stochastically dominates $m^*(\theta)$.*

Proof: First, using Condition II.3, notice that $\theta \geq \psi$ implies $H^\theta \leq H^\psi$. Second, notice that, for every $x \in [L, 1]$, we have:

$$\left[\frac{\theta}{n} \cdot \frac{z(x) - L}{1 - z(x)}\right]^{\frac{1}{n-1}} \geq \left[\frac{\psi}{n} \cdot \frac{z(x) - L}{1 - z(x)}\right]^{\frac{1}{n-1}},$$

because $\theta \geq \psi$; and, so, we have $m^*(x|\psi) \leq m^*(x|\theta)$. Together, these two facts are sufficient to prove the lemma. *Q.E.D.*

Here are an additional pair of useful results about the sellers' equilibrium offer distribution implied by Condition II.3.

Lemma II.3: *An $m^* \in M$ satisfying Condition II.3 exists if and only if either:*

(a) $L \geq 0$, or (b) both $L < 0$ and $\theta \in [0, -\frac{n}{L}]$.

Proof: By inspection of Condition II.3, we see that $m^*(\theta) \in M$ if and only if $H^\theta \in [0, 1]$. Since $\theta \geq 0$, $H^\theta \in [0, 1]$ whenever $L \geq 0$. And, when $L < 0$, it is easy to see that $H^\theta \in [0, 1]$ if and only if $\theta \in [0, -\frac{n}{L}]$. *Q.E.D.*

This result establishes that, when the enforcement boundary is defined so that $L < 0$, B must be at least somewhat diligent (i.e. we need $\theta \leq -\frac{n}{L}$) in order for a solution to Condition II.3 to exist. The upper bound on θ identified in Lemma II.3, which represents a *lower bound* on the buyer's diligence, helps to prove existence of an interior equilibrium for $L \ll 0$.

The next result states that there is a unique level of B 's diligence, denoted θ^* , such that the corresponding $m^*(\theta^*)$ satisfies Condition II.3 and such that the expected offer to the buyer, when the sellers choose $m^*(\theta)$, equals zero.

Lemma II.4: *Suppose $L < 0$. There exists a unique $\theta^* \in (0, -\frac{n}{L})$ such that $v_B^{nr} \circ m^*(\theta^*) = 0$.*

Proof: Lemma II.1 shows $v_B^{nr} \circ m^*(\theta^*)$ is a decreasing function. By inspection, $v_B^{nr} \circ m^*(0) = 1$ and $v_B^{nr} \circ m^*(-\frac{n}{L}) = L < 0$. Combining both of these with the fact that $v_B^{nr} \circ m^*$ is continuous in θ , it is easy to see that there is an intermediate value θ^* such that $v_B^{nr} \circ m^*(\theta^*) = 0$. *Q.E.D.*

Therefore, whenever $L \leq 0$, a unique θ^* exists such that the associated $m^*(\theta^*)$, satisfying Condition II.3, also makes B indifferent between accepting and rejecting when she does not read the offers, and thus willing to choose an interior value of p^* by Condition II.1.

Next, I provide a complete proof of Theorem II.1 on the existence of an interior equilibrium in the *RCM*.

Theorem II.1: *Suppose that:*

$$L < \frac{n\bar{e}}{\bar{e} - 1}.$$

Then a boundary equilibrium does not exist and a unique interior equilibrium exists.

Proof: Using Lemma II.4, given $L < 0$, there is a unique $\hat{\theta} \in (0, -\frac{n}{L})$ such that $v_B^{nr} \circ m^*(\hat{\theta}) = 0$. And, there is subsequently a unique $\hat{m} = m^*(\hat{\theta})$ that satisfies Condition II.3. Furthermore, given Assumption II.1, it is possible to identify the

unique reading investment \hat{e} such that:

$$c'(\hat{e}) = v_B^r(\hat{m}),$$

which is the appropriate requirement, regardless of the value of p , because $v_B^{nr}(\hat{m}) = 0$. Further, $\hat{e} > 0$, because $\hat{\theta} > 0$; and $\hat{e} < \bar{e}$ because $v_B^r(\hat{m}) < 1$. To finish the construction then, it remains only to be shown that there is an appropriate $\hat{p} \in (0, 1)$ which, together with reading investment \hat{e} , will yield diligence level $\hat{\theta}$. First, notice that $0 < \hat{e} \leq \bar{e} < 1$ and $0 < \hat{\theta} < -\frac{n}{L}$ imply:

$$\frac{\hat{e} \cdot \hat{\theta}}{(1 - \hat{e})} > 0.$$

Second, it is clear that:

$$\frac{\hat{e} \cdot \hat{\theta}}{(1 - \hat{e})} < \frac{n \cdot \hat{e}}{L(\hat{e} - 1)} \leq \frac{n \cdot \bar{e}}{L(\bar{e} - 1)} \leq 1,$$

where the final inequality is implied by the condition $L \leq \frac{n \cdot \bar{e}}{(\bar{e} - 1)}$. This means it is possible to isolate a unique acceptance probability $\hat{p} \in (0, 1)$ such that, when combined by B with reading effort \hat{e} , result in a diligence parameter value of:

$$\hat{\theta} = \frac{(1 - \hat{e})\hat{p}}{\hat{e}}.$$

Thus it is possible, whenever the lower limit on offers that satisfies $L \leq \frac{n \cdot \bar{e}}{(\bar{e} - 1)}$, to construct a strategy profile $(\hat{m}, \hat{e}, \hat{p}) \in \Gamma^I(L)$. And in fact, we know that $(\hat{m}, \hat{e}, \hat{p}) = \Gamma^I(L)$ because Assumption II.1 implies that $c'(\cdot)$ is a strictly increasing function on the domain $[0, 1]$. Finally, there cannot exist a boundary equilibrium, because in this case $v_B^{nr} \circ m(e^*, 1) \geq 0$ requires $e^* \geq \bar{e}$, a level of reading at which Condition II.2 cannot be satisfied. *Q.E.D.*

Theorems II.2 and II.3, respectively, contain approximations, for a large number of sellers, of the sets of interior and boundary equilibria in the general reading costs model, for any enforcement boundary L .

Theorem II.2: Fix $L < 0$ and let

$$\bar{m}(x) = \begin{cases} 0 & \text{if } x < L \\ \frac{1}{1-L} & \text{if } x \in [L, 1) \\ 1 & \text{if } x \geq 1 \end{cases}.$$

Suppose $(m_n^*, e_n^*, p_n^*)_{n=2}^\infty$ is a convergent sequence of equilibria with reading. Then $(m_n^*, e_n^*, p_n^*)_{n=2}^\infty \rightarrow (\bar{m}, \bar{e}, 0)$.

Proof: To start, notice that the equilibrium conditions, Conditions II.1, II.2, and II.3 are upper-hemicontinuous in the parameter n . Since the set of strategy profiles, Σ is compact, this implies that any sequence constructed by taking the unique equilibrium with reading for an increasing number of sellers, n , will have a convergent subsequence which has as its limit the strategy profile that is obtained by solving the limiting equilibrium conditions. See [58].

First, using Condition II.3, it is clear that $\lim_{n \rightarrow \infty} H^\theta = 1$ for every θ and every L , which implies, by Condition II.2, that we must have $\lim_{n \rightarrow \infty} e_n^* = \bar{e}$ if it is the case that $v_B^{nr}(m^*) = 0$.

Next, I use Condition II.3 to compute the limiting distribution of the sellers' (symmetrically chosen) equilibrium strategy, fixing $e = \bar{e}$ and using p_n^* to represent the buyer's equilibrium acceptance probability. For each offer $x \in [0, 1)$, looking at Condition II.3, we must have:

$$\begin{aligned} \lim_{n \rightarrow \infty} m^*(x | e_n^*, p_n^*) &= \lim_{n \rightarrow \infty} \left(\frac{1}{n}\right)^{\frac{1}{n-1}} \cdot \left(\frac{1-\bar{e}}{\bar{e}}\right)^{\frac{1}{n-1}} \cdot (p_n^*)^{\frac{1}{n-1}}, \\ &= \lim_{n \rightarrow \infty} (p_n^*)^{\frac{1}{n-1}}. \end{aligned}$$

The last equality follows from the fact that $\lim_{n \rightarrow \infty} a^{\frac{1}{n-1}} = 1$ whenever $a > 0$. Let $Y_L \equiv \lim_{n \rightarrow \infty} (p_n^*)^{\frac{1}{n-1}}$, and notice that:

$$v_B^{nr}(\bar{m}) = Y_L \cdot L + (1 - Y_L) \cdot 1;$$

and, in an interior equilibrium, we must also have:

$$v_B^{nr}(\bar{m}) = 0,$$

which implies that:

$$Y_L = \frac{1}{1 - L}.$$

Therefore, the limit of the sellers' symmetric equilibrium strategy is, evaluating Condition II.3 when $n \rightarrow \infty$, must be as is indicated in the theorem. And this implies

$$\lim_{n \rightarrow \infty} p_n^* = \lim_{n \rightarrow \infty} \left(\frac{1}{1-L} \right)^{n-1} = 0,$$

since $L < 0$ is required for an interior equilibrium to exist. *Q.E.D.*

Theorem II.3: Fix $L \geq 0$ and let:

$$\underline{m}(x) = \begin{cases} 0 & \text{if } x < L \\ 1 & \text{if } x \leq L \end{cases}.$$

Suppose that $(m_n^*, e_n^*, 1)_{n=2}^\infty$ is a convergent sequence of boundary equilibria. Then $(m_n^*, e_n^*, 1)_{n=2}^\infty \rightarrow (\underline{m}, 0, 1)$.

Proof: Again, we can argue, given compactness of Σ and upper-hemicontinuity in n of the Conditions II.1, II.2, and II.1, that the limit of any convergent sequence of boundary equilibria indexed by n and when $L \geq 0$ is fixed will be approximated by the solution to the limits, as $n \rightarrow \infty$, of the equilibrium conditions.

Now, to solve the limiting conditions, Condition II.3 implies that, for each $x \geq 0$ and for each $e > 0$,

$$\lim_{n \rightarrow \infty} m^*(x|e, 1) = \lim_{n \rightarrow \infty} \left(\frac{1}{n} \right)^{\frac{1}{n-1}} \left(\frac{1-e}{e} \right)^{\frac{1}{n-1}} \left(\frac{x-L}{1-x} \right)^{\frac{1}{n-1}} = 1.$$

This means that if the buyer chooses $p^* = 1$, which is necessary for a boundary equilibrium, then, regardless of what positive reading investment she chooses, Condition II.3 implies the sellers will offer $x = L \geq 0$ with probability 1. In turn, B must choose e^* in the limiting equilibrium with reading, by Condition II.2. *Q.E.D.*

To finish this section, I prove the results stated in Section II.E on the Binary-Offers case of the *RCM*.

Lemma II.2: $\lim_{n \rightarrow \infty} n \cdot \gamma(q, n) = \frac{1}{1-q}$.

Proof: Notice that:

$$\begin{aligned} n \cdot \gamma(q, n) &= \frac{1}{(1-q)} \sum_{j=1}^n \binom{n}{k+1} q^{n-j} (1-q)^j, \\ &= \frac{1-q^n}{1-q}. \end{aligned}$$

This is enough to prove the lemma, since the righthand side of the above equation clearly has the desired limit when $n \rightarrow \infty$. *Q.E.D.*

Theorem II.4: *Suppose that $(q^*, e^*, p^*)_{n=2}^{\infty}$ is a convergent sequence of equilibria with reading. Let:*

$$L^* \equiv \frac{\bar{e}(H-1)}{1-\bar{e}}.$$

If $L < L^$, then $(q^*, e^*, p^*)_{n=2}^{\infty}$ converges to the limiting equilibrium $(\tilde{q}, \tilde{e}, \tilde{p})$ defined by the equations:*

- i) $\tilde{q} = \frac{H}{H-L}$;*
- ii) $\tilde{e} = \bar{e}$;*
- iii) $\tilde{p} = \frac{\bar{e}(1-H)}{L(\bar{e}-1)}$.*

If $L = L^$, then the limiting equilibrium is defined by:*

- i) $\tilde{q} = \frac{H(1-\bar{e})}{H(1-\bar{e})+(1-H)\bar{e}}$;*
- ii) $\tilde{e} = \bar{e}$;*
- iii) $\tilde{p} = 1$.*

Finally, if $L > L^$, then the limiting equilibrium is defined by:*

- i) $\tilde{q} = \frac{c'(\bar{e})}{H-L}$;*
- ii) $\tilde{e} = \frac{(1-\tilde{q})(H-L)}{1-H+(1-\tilde{q})(H-L)}$;*
- iii) $\tilde{p} = 1$.*

Proof: Once again, Conditions II.1, II.2, and II.3 are upper-hemicontinuous in the parameter n , and therefore the limiting equilibrium, $(\tilde{q}, \tilde{e}, \tilde{p}) \in \Sigma$, computed by solving the equilibrium conditions after taking limits as $n \rightarrow \infty$, will be arbitrarily close, for sufficiently large n , to any actual component, $(q_\eta, e_\eta, p_\eta) \in \Sigma$ where $\eta \gg 2$, of a convergent sequence of equilibria with reading. Therefore, it is enough to compute the limiting equilibrium equations for the three separate cases indicated in the theorem and to show they imply the use of the strategy profiles that are described.

First, consider the case where $L < L^*$. I construct an interior equilibrium with reading, $(\tilde{q}, \tilde{e}, \tilde{p})$, which is unique. Using Condition II.1, it is required that

$$v_B^{nr} = \tilde{q}L + (1 - \tilde{q})H = 0,$$

which means that the sellers will offer L with probability:

$$\tilde{q} = \frac{H}{H - L}.$$

Since $\tilde{q} < 1$, this implies $v_B^r(\tilde{q}) = H$ when $n \rightarrow \infty$. Therefore, using Condition II.2, we know that:

$$c'(\tilde{e}) = H - 0 = H,$$

and consequently $\tilde{e} = \bar{e}$. Finally, we need any seller's payoff from offering H to equal the payoff from offering L , given that the other sellers offer L with probability \tilde{q} and given that B chooses reading investment $\tilde{e} = \bar{e}$ and the acceptance probability \tilde{p} which is to be determined. Using Condition II.5, we can see that:

$$(1 - L)(1 - \bar{e})\tilde{p} = (1 - H)\left[\frac{\bar{e}}{1 - \tilde{q}} + (1 - \bar{e})\tilde{p}\right];$$

which is equivalent to the requirement:

$$\tilde{p} = \frac{\bar{e}(1 - H)}{L(\bar{e} - 1)}.$$

The righthand side of this equation is strictly between 0 and 1, because $L < L^* < 0$, $\bar{e} \in (0, 1)$, and $H \in (0, 1)$. Therefore, for the case $L < L^*$, we have shown that $(\tilde{q}, \tilde{e}, \tilde{p})$ as described in the theorem is the unique limiting equilibrium with reading.

Next, notice that when $L = L^*$ it is possible to construct a limiting equilibrium with reading using the same process as above, where now it is easy to verify that $L = L^*$ implies $\tilde{p} = 1$.

Finally, take the case where $L > L^*$. I show that a limiting equilibrium must exist, and further, it must be a boundary equilibrium with $\tilde{p} = 1$. To begin, rearrange Condition II.5, with $\tilde{p} = 1$, to obtain:

$$\tilde{e} = \rho(\tilde{q}) \equiv \frac{(1 - \tilde{q})(H - L)}{1 - H + (1 - \tilde{q})(H - L)},$$

where $\rho : [0, 1] \rightarrow [0, 1]$ is continuous and strictly decreasing, with $\rho(0) = \frac{H-L}{1-L}$ and $\rho(1) = 0$. Next, if $\tilde{p} = 1$, then, by Condition II.2, this means that

$$c'(\tilde{e}) = \tilde{q}(H - L).$$

And given Assumption II.1, this equation can be written: $\tilde{e} = \gamma(\tilde{q})$, where $\gamma \equiv (c')^{-1}$ exists, is continuous, and is strictly decreasing with $\gamma(0) = 0$ and $\gamma(1) > 0$. Combining these facts, we know there is a unique value $\tilde{q} \in (0, 1)$ such that $\rho(\tilde{q}) = \gamma(\tilde{q}) = \tilde{e} \in (0, 1)$, and further, the relationship between \tilde{e} and \tilde{q} must be as is specified in the theorem. The final requirement to verify is $v_B^{nr}(\tilde{q}) \geq 0$, which, from Condition II.1, is required for B to be willing to select $\tilde{p} = 1$. This is equivalent to the requirement that:

$$\tilde{q} \leq \frac{H}{H - L}.$$

This is guaranteed by the condition $c'(\tilde{e}) = \tilde{q}(H - L)$, since $\tilde{e} < \bar{e}$ and $c'(\bar{e}) = H$. *Q.E.D.*

III

Contract Formation and Enforcement with Two-Sided Asymmetric Information and Reading Costs

III.A Introduction

Many economic relationships involve contracts, so it is useful to understand the process of contract formation. In practice, contracts are often somewhat complicated, and, at a glance, an agent faced with a decision about whether to accept a contract offered to her or him frequently will not be able to evaluate the payoff impact of the proposed contract without spending some time to read it, which implies the existence of a positive *opportunity cost of reading*, even if the individual is being paid to do the reading, professionally somehow.

This is certainly the case in many types of consumer sales contractual relationships. I assert that contracting between individual consumers and firms about just about any type of private insurance will generally fit into this simple framework. Typically, the insurance company offers a contract, or menus of con-

tracts, written in standard form and containing some amount of fine print. It is then up to the individual consumer, who seeks insurance, to process the information in each contract, and to decide whether to accept a particular contract. If the offered contract is complex, the individual may decide to spend a considerable amount of time and effort to read it, or may end up accepting it without reading every term in detail. The latter case is often observed in practice.

In this chapter, I focus on generalizing the monopoly case of the *RCM* (which is analyzed thoroughly in Section II.H) to include the possibility that two-sided asymmetric information exists between the buyer, B , and the monopolist single-seller, S . Consequently, I refer to the model of this chapter as the asymmetric-information reading costs model, or *AIRCM*. In the *AIRCM*, before contract negotiations start, S and B receive private information about a parameter affecting the potential payoffs in contracting. Then, S makes a contract offer to B , who in turn must decide how much effort to invest to read the contract. Reading effort, costly to B , effects the probability with which B succeeds at reading S 's contract, and, so, reading effort equals the probability that B will learn the exact payoff implications of the proposal. After the outcome of the reading process is determined, the buyer makes a decision about whether to accept the seller's offer. The buyer's acceptance decision concludes contract negotiation, and then the payoffs associated with the contract obtain (or payoffs of the players' outside option obtain if S does not make an offer or the contract is rejected).

In Section III.C, I characterize the set of sequential equilibria of the *AIRCM*, for any given legally mandated limitation, $H \leq 1$, on the highest offer that S may receive in a contract which is enforced by the court (where 1 is the maximum possible surplus). The characterization of equilibria in the *AIRCM* reveals two significant facts. First, the model has a sequential equilibrium in which the buyer, regardless of his type, does not invest a positive amount ($e = 0$) to read the seller's offer. Second, there is no other sequential equilibrium of the model, and in particular, this means that there is no sequential equilibrium in which the

buyer does invest a positive amount $e > 0$ to read the seller's offer.

It is easy to see how to construct a *no-reading equilibrium* in the *AIRCM*. Suppose that, when B 's private value is $v < H$, B chooses not to read or accept S 's offer, and, when B 's private value is $v \leq H$, B chooses $e = 0$ but accepts S 's offer for certain. Given this strategy for B , S will find it optimal to offer H when $w \leq H$, and he will not make an offer if $w > H$. And, given this strategy for S , B receives a contract offer only if it promises H ; and so it is optimal for B to choose $e = 0$ and to accept if and only if $v \geq H$. Notice that this explanation implicitly exploits an assumption about the nature of trade and enforcement in contracting, where a seller of type $w < L$ must not want to make an offer since any offer that is enforced will give the seller a negative payoff. One way to justify this comes with further scrutiny about the way that payoffs from contracting between B and S actually are realized. Then, the situation that I am analyzing in my treatment of the *AIRCM* is equivalent to one in which B becomes aware of the exact nature of the contract with S —even if the reading investment in Stage 2 is not successful—if and when B accepts S 's offer. Accepting the offer yields the same information as successful reading, and this means that B will be able to alert the enforcer whenever the seller makes an unenforceable offer that is accepted.¹

The intuition behind the result that there is not an *equilibrium with reading* in the *AIRCM* is also simple, and it reflects the essential logic of Akerlof in [2] about markets with asymmetric information. Any attempt to construct an equilibrium in which any type of seller makes an offer less than H (with positive probability) will *unravel*. Consider some type of seller offering the buyer the most attractive contract. Certainly, if that seller reduces the value of the offer to the buyer, then the seller may lose the opportunity to contract with a type of buyer who, after reading the offer, will not find it acceptable, but who would have accepted had the seller not reduced the offer's value. However, this loss will not have a substantial impact on the seller's expected payoff, since a buyer whose private

¹The situation is no less rigorously linked to the phenomenon of the emergence of the generally accepted practice of *shrink-wrapping* software warranties and other similar contractual devices.

value is such that the highest offer is just marginally acceptable must read only with negligible probability. Indeed, the expected gain that the seller gets by lowering the value of this highest offer, which accrues since every contract that is still accepted must now give the seller a strictly higher payoff, has to justify taking any such corresponding negligible expected loss! Therefore, the buyer knows that any contract offer will equal H , and we must be back in the no-reading case that I have described.

Section III.D contains a discussion of the possible impacts on efficiency of various limits on enforcement of contracts—the socially efficient enforcement boundary is computed in an example. In Section III.E, I briefly discuss the impact on possible contract payoffs associated with various existing legal doctrines used to govern contracting currently in the United States, such as the *penalty doctrine* and the performance excuse of *substantive unconscionability*. I also explain how the structure of the *AIRCM* approximates situations of standard form contracting in the real world, and I discuss some of the possible merits and drawbacks of enforcing standard form agreements. Finally, in Section III.F I speculate about the robustness of my no-reading equilibrium-only results to possible changes in the negotiation structure, where generally we could imagine characterizing the equilibria of any game with reading.

III.B The Reading Costs Model with Two-Sided Asymmetric Information

In this section, I describe the details of the *asymmetric information reading costs model (AIRCM)*. In the *AIRCM*, a buyer, B , has the opportunity to contract with a seller, S .² Initially, B and S learn the values of privately observed random variables, or their *types*, that represent factors determining the extent to which productive activities will generate surplus. Specifically, B observes private

²Therefore, the *AIRCM* is, strictly speaking, most directly a generalization of the the monopoly case of the *RCM*, the *MRCM*, that I analyze in Section II.H.

value v , which is distributed according to the cumulative distribution function (c.d.f.) β , with support $[0, 1]$, and S observes private value w , which has c.d.f. σ , with support $[0, 1]$. I assume that the distributions, β and σ , are continuous and independent. For example, v might represent private information that B receives about willingness to pay for a particular good; and w might represent private information the seller has about costs of producing the good.

Negotiation over contract terms, as modeled in the *AIRCM*, conforms to a specific structure.³ After the parties have observed their values, the seller has the opportunity to make a contract offer to the buyer. A contract offer, $x \in [0, H]$, determines the division of value (if any) created in the productive activity, where $H \geq 0$ represents the upper bound on enforcement that is imposed by prevailing contract law. ϕ_w represents a typical mixed-strategy offer distribution that the seller chooses when his type is w , and $\phi = \{\phi_w\}_{w \in [0,1]}$ is the type-dependent mixed strategy.⁴ Also, $y_\phi(w) \equiv \min\{\text{supp}\{\phi_w\}\}$; this is the minimum offer that the seller makes with positive probability, given his type w , when he chooses the type-dependent mixed-strategy ϕ . Finally, associated with any ϕ are an induced *ex ante offer distribution*:

$$\mu(x) \equiv \mu(x|\phi) \equiv \int_0^1 \phi'_w(x) d\sigma(w).$$

and the resulting value $x_\phi \equiv E[x|x \sim \mu]$.

Alternatively, the seller can choose not to offer a contract to the buyer (if his type is $w > H$). If the seller does not make an offer, then the game ends, but if the seller makes an offer, then the buyer has an opportunity to read it.⁵

³As I explain in Section III.E, the negotiation structure of the *AIRCM* conforms, at least partially, to typical negotiation that occurs between a firm and a consumer over a sales contract, such as is the case in insurance relations. However, I argue in Section III.F that my characterization of no-reading equilibrium in the *AIRCM* can be extended to a much more general negotiation structure in which the buyer receives sequential offers from any number different of sellers. It is only when sellers engage in strong, simultaneous competition, as in the *RCM* of Chapter II, that the buyer will ever invest a positive amount to read a contract.

⁴Technically, I include the decision to not to make an offer as part of the set of possible decisions S can make that are represented by his choice of ϕ .

⁵The parameter H is of interest, because the enforcement authority will want to set H optimally to encourage socially efficient contracting, which I explain further in Section III.D.

If the seller makes an offer, the buyer with type v chooses an investment level, e_v , which represents the probability that she *reads* the seller's contract offer. I let $e = \{e_v\}_{v \in [0,1]}$ represent the buyer's type-dependent set of reading investments. If the buyer reads the offer, then the buyer knows with certainty the value of the promise x .⁶ If the buyer *does not read* the seller's offer, then the buyer only has a (generally imperfect) belief about what the seller has offered, where this belief is represented by a probability distribution over possible enforceable offers. (In a sequential equilibrium, this belief is determined by actual type-dependent mixed-strategy offer distribution that the seller chooses.)

After the outcome of the buyer's reading investment is determined, the buyer makes a decision about whether to accept or reject the seller's offer. If the buyer reads the seller's contract, then this acceptance decision is made with exact knowledge of x . If the buyer has not read the offer, then the buyer must make the acceptance decision given restricted information and ultimately only on the basis of her beliefs about what the seller may have offered. I let p_v represent the probability that B , when her type is v , accepts the seller's offer after not reading it, and I let $p = \{p_v\}_{v \in [0,1]}$ represent the set type-dependent of acceptance probabilities. B 's acceptance or rejection decision represents the final stage of the *AIRCM*.

If the buyer's private value is v and the seller's private value is w , and if the buyer accepts an offer of x after making reading investment e , then the seller's payoff is:

$$u_s(x|w) = x - w,$$

and the buyer's payoff is

$$u_b(x, e|v) = v - x - c(e),$$

where $c(e)$ is the buyer's *reading cost function*. If the buyer rejects the seller's contract after investing at level e , then the seller gets a payoff of 0 and the buyer

⁶This is because she *understands* the meanings of each of the individual terms of the proposed arrangement and how they will be able to work in concert together with each other to generate an enforceable and desirable agreement.

gets a payoff of $-c(e)$. For simplicity, I have assumed that both S and B are risk-neutral.⁷

Assumption III.1: $c(\cdot)$ satisfies $c(0) = 0$, $c(1) > 1$, $c'(0) = 0$, $c'(1) > 1$, and $c''(\cdot) > 0$.

This is a weak assumption, which says that the buyer's reading cost function is strictly convex. The issue of interest will be whether the parties are able to reach an agreement on a contract, given that the buyer must invest to read the seller's offer, when there is some positive surplus to be realized (that is, when v exceeds w).

Before turning to the characterization of sequential equilibrium in the *AIRCM*, I establish some additional notation that is helpful for a precise statement of the results. In the analysis of sequential equilibrium, it is necessary to consider the players' *interim expected payoffs*, which they expect, given a strategy for the other player, after they have observed their private information but before they have executed their own strategies.

First, given a choice ϕ by the seller and the resulting $\mu(\cdot|\phi)$, a buyer of type v has, associated with any e_v , the interim expected payoff:

$$\pi^B(e_v|v) \equiv e_v \int_v^1 (v-x)d\mu(x|\phi) + (1-e_v) \max\{0, v-x_\phi\} - c(e_v).$$

Also, the interim expected payoff to the seller from making an offer x with certainty when his type is w and when the buyer chooses an arbitrary strategy (e, p) , must be:

$$\pi^S(x|w) \equiv (x-w) \left\{ \int_0^1 (1-e_v)p_v d\beta(v) + \int_x^1 e_v d\beta(v) \right\}.$$

III.C Equilibrium Analysis of the *AIRCM*

In this section, I characterize the sequential equilibria of the *AIRCM*, for an arbitrary $H \in [0, 1]$. The characterization theorem leads to a natural corollary

⁷I discuss, in Chapter II, whether the possibility that $c(e) > 0$ for at least one e , must imply that the *AIRCM* is a model of bounded rationality. [14] classifies and describes various models of bounded rationality.

(Corollary III.D) about the important impact that limited enforceability of contracts can have on economic efficiency when parties to a contract face substantial reading costs.

The first requirement for a strategy profile (ϕ^*, e^*, p^*) to be a sequential equilibrium of the *AIRCM* is that if the seller has made an offer that the buyer of type v has not read, then the buyer will accept it if and only if:

$$p_v^* = \begin{cases} 1 & \text{if } v \geq x_{\phi^*} \\ 0 & \text{if } v < x_{\phi^*} \end{cases}. \quad (\text{III.1})$$

which means that the expected offer, given the seller's type-dependent mixed strategy, is low enough for the buyer to find it acceptable given his type. Notice that the discontinuity of p_v^* at $v = x_{\phi^*}$ will not wreak havoc on the topology of the equilibrium manifold in the *AIRCM*, since $v = v_B^{tr}$ is a zero probability event given my assumptions about the distribution function β .

The next requirement for a sequential equilibrium is that, when her type is v , and when the seller plays the strategy ϕ^* , the buyer chooses the reading investment e_v^* to maximize $\pi^B(e_v|v)$. This objective function is differentiable in the effort e_v , by Assumption III.1. And, the associated first-order necessary condition for an optimal level of reading effort, e_v^* , is:

$$c'(e_v^*) = \int_v^1 (v - x) d\mu(x|\phi^*) - \max\{0, v - x_{\phi^*}\}. \quad (\text{III.2})$$

This condition says that the marginal cost of the reading investment to the buyer is equal to its marginal benefit, where this is the increase in the expected payoff from reading that exists because the buyer is able to verify the content of the seller's offer exactly.

The third requirement for a sequential equilibrium is on ϕ^* . The seller, when his type is w , must be indifferent between offering H and offering any $x \in (0, H)$ which is in $\text{supp}\{\phi^*\}$, given the buyer's type-dependent reading investment choice e and her acceptance strategies. So, for every $x \in \text{supp}\{\phi^*\}$

$$\pi^S(x|w) = \pi^S(H|x). \quad (\text{III.3})$$

Together, these requirements determine the definition of sequential equilibrium in the *AIRCM* that is used in the characterization result, Theorem III.1.

Definition III.1: (ϕ^*, e^*, p^*) is a **sequential equilibrium of the *AIRCM*** if: for every v , p_v^* satisfies Condition III.1 when S chooses ϕ^* ; for every v , e_v^* satisfies Condition III.2 when S chooses ϕ^* ; and, finally, for every w , ϕ_w^* satisfies Condition III.3 when B chooses e^* and p^* .

Given the definition of sequential equilibrium in the *AIRCM*, we can consider what the set of sequential equilibria might actually be like. It turns out that a straightforward characterization is readily available, and, as I have stated in the introduction to this chapter, it largely builds off of the intuition established by [2].

Theorem III.1: *The following strategy profile is the unique sequential equilibrium of the *AIRCM*. If $w \leq H$, S offers $x_w = H$, and otherwise S does not make an offer; if S makes an offer, B invests $e_v = 0$; and if $v \geq H$, then B accepts S 's offer, and otherwise B rejects S 's offer.*

Here is a short description of the proof of Theorem III.1; there are four primary components. To start, I argue that in any sequential equilibrium of the *AIRCM* the seller will never offer strictly lower than H , regardless of his type. To do this, first, I show that $y(\cdot)$ is a weakly decreasing function of the seller's own type in any sequential equilibrium (Lemma III.1) which implies $\underline{y}_\phi \equiv y_\phi(0) = \min y_\phi(w)$.

Second, (Lemma III.2) in any sequential equilibrium, for a given $\epsilon > 0$, there exists a number $\delta > 0$ such that a buyer with a type v satisfying $v < \underline{y}_\phi + \delta$, chooses a level of reading effort less than ϵ .

Third, given Lemma III.2, if $\underline{y}_\phi < H$, then the seller would benefit by increasing the minimum offer made with positive probability when his type is $w = 0$. And, in conjunction with Lemma III.1, this is enough to prove that there is no sequential equilibrium of the *AIRCM* in which the buyer invests a positive amount to read the seller's offer, because the value \underline{y}_ϕ was chosen arbitrarily.

Finally, I demonstrate that the strategy profile described in Theorem III.1 is in fact a sequential no-reading equilibrium of the *AIRCM*. Obviously, if the buyer will only receive the offer H , then the buyer would do best not to invest to read, and to accept if only if $v \geq H$. But this strategy justifies the seller's decision to offer $x_w = H$ if and only if $w \leq H$ and not to make an offer otherwise, and the no-reading equilibrium is established.

Lemma III.1: *If (ϕ^*, e^*, p^*) is a sequential equilibrium, then y_{ϕ^*} is a weakly decreasing function.*

Proof: The seller's interim expected payoff evidently satisfies $\frac{\partial^2 \pi^S}{\partial x \partial w} \leq 0$, which can be shown using Leibnitz's Rule. And so $\frac{\partial y_{\phi^*}}{\partial w} \leq 0$ whenever (ϕ^*, e^*, p^*) is a sequential equilibrium. *Q.E.D.*

The intuition behind this result is nice. An increase in the seller's type implies an increase in the set of buyer-types that are able to form a productive relationship with the seller. However, this set is increased only with the addition of extra buyer-types with relatively low magnitudes of v that were not previously candidates for efficient exchange with the seller; therefore, to take advantage of these additional contractual opportunities, the seller would need to shift some probability mass in his mixed strategy toward some higher offers that were previously not being made.

The next lemma is used to help argue that the seller will always benefit by reducing the probability with which the maximal offer is made, and making a lower offer with subsequently higher probability.

Lemma III.2: *Given $\epsilon > 0$, there is a $\delta > 0$ such that in any sequential equilibrium any buyer of type v satisfying $v < \underline{y}_{\phi} + \delta$ must choose a reading effort level $e_v < \epsilon$.*

Proof: Notice that $\underline{y}_{\phi} = \min\{\text{supp}\{\mu\}\}$, using Lemma III.1. By direct computation:

$$\lim_{v \rightarrow \underline{y}_{\phi}} \int_v^{\underline{y}_{\phi}} (v - x) d\mu(x|\phi) - \max\{0, v - x_{\phi}\} = 0.$$

Therefore, given any $\epsilon > 0$, there exists a $\delta > 0$ such that, if $v < \underline{y}_\phi + \delta$, then

$$\int_v^{\underline{y}_\phi} (v - x) d\mu(x) - \max\{0, v - x_\phi\} < c'(\epsilon).$$

And, consequently a buyer with type $v < \underline{y}_\phi + \delta$ must choose a reading effort level $e_v < \epsilon$, because $c(\cdot)$ satisfies Assumption III.1. *Q.E.D.*

As I have indicated, I use Lemmas III.1 and III.2 in proof of Theorem III.1 to demonstrate that there is no sequential equilibrium of the *AIRCM* in which a seller of any type will offer any contract other than H with positive probability.

Proof of Theorem III.1: Suppose that the type-dependent strategy profile $(\hat{\phi}, \hat{e}, \hat{p})$ is a sequential equilibrium and is such that $\underline{y}_{\hat{\phi}} < H$; I derive a contradiction. The marginal payoff that a seller of type w expects, associated with an increase in offer x , evaluated at $w = 0$ and $x = \underline{y}_{\hat{\phi}}$, is therefore:

$$\frac{\partial \pi^s}{\partial x}(\text{at } w = 0, x = \underline{y}_{\hat{\phi}}) = \int_0^1 (1 - \hat{e}_v) \hat{p}_v d\beta(v) + \int_{\underline{y}_{\hat{\phi}}}^1 \hat{e}_v d\beta(v) - A,$$

where $A \equiv (\underline{y}_{\hat{\phi}} - w) \hat{e}_{\underline{y}_{\hat{\phi}}} \beta'(\underline{y}_{\hat{\phi}})$. Notice $A = 0$, because $\hat{e}_{\underline{y}_{\hat{\phi}}} = 0$ by Lemma III.2. Also, the second term on the righthand side is nonnegative. And, finally, either $\hat{e}_v = 1$ or $\hat{p}_v = 0$ for every v or the first term on the righthand side must be strictly positive.

So I have shown that either $\hat{e}_v = 1$ or $\hat{p}_v = 0$ for every v or S , with type $w = 0$, could increase his payoff by switching away from $\hat{\phi}$ when B chooses (\hat{e}, \hat{v}) , which would contradict the assertion that $(\hat{\phi}, \hat{e}, \hat{v})$ is a sequential equilibrium. But, also, the possibility that $\hat{e}_v = 1$ for any v is ruled out if $(\hat{\phi}, \hat{e}, \hat{p})$ is a sequential equilibrium, because then $\hat{e}_v > \bar{e}$. And the possibility that $\hat{p}_v = 0$ for every v is ruled out when $\underline{y}_{\hat{\phi}} < H$, because in this case B could increase his payoff when his type is near 1 by choosing $p_v > 0$. Therefore, it is established that: if $\underline{y}_{\hat{\phi}} < H$, then the associated $(\hat{\phi}, \hat{e}, \hat{v})$ is not a sequential equilibrium.

Since the value $\underline{y}_{\hat{\phi}} < H$ was chosen arbitrarily, the above argument can be combined with Lemma III.1 to establish that, in any equilibrium, the seller, if $w \leq H$, offers $x = H$ with certainty, and, of course, if $w > H$, does not make an

offer. This means that, in any equilibrium, the buyer, regardless of type, chooses effort $e_v = 0$; also a buyer of type $v \geq H$ must accept the seller's offer; and a buyer of type $v < H$ must reject the seller's offer.

Notice that, if the buyer does not exert positive effort to read the seller's offer, then seller, if his type satisfies $w \leq H$ must find it optimal to offer H . And, it will always be the case that $w > H$ implies the seller will not want to make an offer. If the seller chooses this strategy, the buyer, irrespective of type, will find it optimal, by Condition III.2 choose to exert zero effort, and will accept any offer if $v \geq H$ and will reject otherwise. Therefore, the strategy profile described in Theorem III.1 is in fact the unique sequential equilibrium of the *AIRCM*. *Q.E.D.*

The proof of Theorem III.1 utilizes the unraveling of any attempt to support, as part of a sequential equilibrium, offers by any type of seller that are strictly below the cut-off enforceable value H . It is clear from the theorem that the buyer will not, in any sequential equilibrium of the *AIRCM*, invest a positive amount to read the seller's offer. Since the contract has a non-random value, the buyer will never find it optimal to invest to read it.

However, and this is the key point about the design of doctrines governing contract enforcement, contracting can still result in production and realization of surplus, and the extent to which efficiency may or may not be achieved will depend crucially on the legally specified maximum offer, H . In the next section, I suggest a simple method for calculating the expected social surplus generated by various strategy profiles in the *AIRCM*, and I show exactly how the expected social surplus associated with the unique, no-reading equilibrium is affected by choice of the legally imposed enforcement boundary, H .

III.D Relating Limits on Contract Enforcement to Expected Social Surplus in the *AIRCM*

This section contains a method for calculating expected social surplus, for any possible strategy profile, as well as a demonstration of the implied level of expected social surplus generated in the sequential equilibrium of the model and the way in which it is determined by the parameter H . Generally, social (joint) surplus will depend on the probability with which each pair of types establishes a contract, given whatever type-dependent strategy profile ends up being chosen by the parties, and on the discrepancy between the private values of the buyer and seller. Finally, it is necessary to include the buyer's costs of reading, even though, as Theorem III.1 shows, these will be zero in any sequential equilibrium.

A contract between a seller of type w and a buyer of type v generates surplus of magnitude $v - w$. I let $\rho(v, w|\phi, e, p)$ represent the probability that a seller of type w and a buyer of type v reach an agreement, fixing the exact type-dependent strategy profile on which this probability depends. The *ex ante expected surplus*, given a particular strategy profile, and given the joint distribution of seller and buyer types, must equal:

$$W \equiv \int_0^1 \int_0^1 [\rho(v, w|\phi, e, p)(v - w) - c(e_v)] d\beta d\sigma.$$

In the unique no-reading equilibrium of the *AIRCM*, the function $\rho(w, v|\phi, e, p)$ takes a simple form, and characterization of the dependence of W on the enforcement boundary H turns out to be straightforward; the result is a corollary to Theorem III.1. Let

$$W^*(H) \equiv \int_0^H \int_H^1 (v - w) d\beta d\sigma.$$

Corollary III.1: *In the unique no-reading equilibrium of the *AIRCM*, expected social surplus is represented by $W^*(H)$.*

According to Theorem III.1, for any continuous and independent β and σ , any reading cost function satisfying Assumption III.1, and any enforcement boundary H , in the unique no-reading equilibrium of the *AIRCM*, the buyer, with type $v \geq H$, will accept any offer $x \leq H$ and will choose $e_v = 0$, and the buyer, with type $v < H$ will reject any offer and will choose $e_v = 0$. Also, if the seller has type $w \leq H$, he will offer H , and, if the seller has type $w > H$, he will not make an offer. Therefore, if ρ^* denotes the probability that a contract offer will be accepted in equilibrium, then $\rho^*(v, w) = 1$ when both $w \leq H$ and $v \geq H$, but $\rho^*(v, w) = 0$ otherwise. Also, to conclude, recall there are no expenditures on reading in a no-reading equilibrium.

Here is a specific numerical example of the *AIRCM* where I calculate how to maximize, by choice of the enforcement boundary H , the expected social surplus that is generated via the interaction opportunity for the players, using Corollary III.D. Suppose that the players' private values, v and w , are independent and uniformly distributed on the interval $[0, 1]$. Then, the optimal lower limit on enforceable offers, H^* , maximizes the area in the set $[0, 1]^2$ satisfying the conditions: $v \geq H$ and $w \leq H$. Equivalently, H^* maximizes the value $H \times (1 - H)$ which implies that $H^* = \frac{1}{2}$.

III.E Applications to the Economics of Consumer Sales Contracts

Usually, the contracts that firms offer consumers are **standard forms** that firms write that must be accepted or rejected by the consumer (occasionally with negotiated additions or canceled terms of varying degrees of significance). Beginning with the important work of [32] on **contracts of adhesion**, contract theorists have associated the use of standard form contracts with attempts to realize or exploit monopoly power on the part of the firms that use such contracts. However, there is also clear efficiency motivation, vital from an economic perspec-

tive, that suggests standard form contracts should be used and enforced, since they allow a firm to economize on transactions costs associated with negotiating many separate but similar contracts. And, as a consequence, the courts will enforce a standard form contract provided it is verified not to be a contract of adhesion. The existence of this discussion implies it is at least somewhat valuable and realistic to consider a model of consumer sales contracting in which a consumer must read a (standard form) contract that a firm has offered, in a take-it-or-leave-it negotiation structure, and so we have arrived at a justification for interest in analysis of *AIRCM*-type environments from the perspective of a dispassionate and balanced enforcer seeking to learn about the functional relationship between payoff-based limitations on enforcement of standard form contracts and the resulting impact on social efficiency in the affected markets that are governed by these various rules.

But, since reading contracts is costly, it is also necessary to consider the important question: to what extent will the consumer actually understand the standard form contract which the seller has offered at the time of the acceptance decision? For example, [19] notes that, “Standard form contracts are rarely fully read. Even when one reads such a contract one does not always understand all the terms or the expected costs of being obliged by them.” Well, Theorem III.1 demonstrates that the buyer will not invest a positive amount to read in the bilateral monopoly case where the seller writes a (standard form) contract, and this is true regardless of any private information that the buyer and the seller might possess. Theorem III.1 also reveals that payoff-based limitations on the set of enforceable contracts are therefore the crucial determinants of *acceptance* in the *AIRCM* environment, and these enforcement boundaries affect the amount of expected social surplus that is generated in the interaction between B and S .

Of course, it is also important to understand generally how current laws governing contract formation and enforcement affect the situation. Briefly, in disputes, *formation defenses* permit defendants to have contracts voided; *performance excuses* permit defendants to avoid making remunerations for breach, but

the demarcation is not made precise in the *RCM* framework, since enforcement takes place as a black box, and the acceptance decision by *B* or the contracting decision by *S* end the game. So, which existing rules are most directly aimed at limiting the range of possible contract payoffs? I have discussed in Section II.F some existing aspects of U.S. contract law that are directly pay-off based and most relevant. In Subsection II.F.2, I focus on two in particular: *i*) the *penalty doctrine* limits pecuniary damages that can be assessed to a given party in an enforceable contract so that they cannot exceed harm (i.e. they cannot be punitive); and *ii*) the doctrine of *substantive unconscionability* excuses performance in cases of gross disparity in the outcome of contracting, where, I explain, this has the important effect of ruling out the possibility that any particular party to a contract gets a very low payoff (it is an enforcement boundary). Also in Section II.F I discuss how the *RCM* framework allows one to explain the separation of the determinants and effects of substantive unconscionability and procedural unconscionability.

III.F Conclusions and Extensions

This chapter presents a study of contracting in an environment with two-sided asymmetric information and with costs of reading contracts. The practical motivation for studying the implications of reading costs is obvious. If a contract is even somewhat complicated—which presumably must be the case whenever it is helpful for the contract partners to achieve surplus—when it is offered to some party by another, the offeree will not be able to process its implications at zero cost. In this paper, I show, under general conditions of two-sided asymmetric information, that the buyer, who receives a contract offer from the seller, will not invest a positive amount of effort to read the seller’s offer. In order to induce buyers to be willing to establish contracts with sellers, then, given that they will not have read the contract offers, it is crucial that there are controls on enforcement of contracts which the sellers may potentially offer. The analysis concludes with description of

a method for determining the socially efficient limitations that should be imposed on contracting.

One clear concern with the modeling exercise is the specific nature of the negotiation game that is played between the buyer and seller. In particular, I have assumed that the seller makes a take-it-or-leave-it offer to the buyer, and that, then, the buyer makes a single decision about whether to accept the seller's offer. There is at least some weak evidence to suggest that actual negotiation of consumer sales contracts, such as private insurance contracts, rental agreements, and the like, adheres to this type structure; where firms write standard contracts that are proposed to potential buyers by agents who do not have authorization to make significant changes to the standard form. [31], [46], and [19] are examples of studies of standard form contracts where bargaining proceeds largely in this fashion.

However, it is of use to consider whether the conclusions reached in this paper, in particular the assertion that positive reading effort will not be undertaken in any sequential equilibrium, are robust to the specification of the negotiation game. Indeed, it seems that the result is not entirely robust. In Chapter II of this dissertation, I showed that if sellers engage in simultaneous competition, where two or more sellers offer contracts to buyers who face reading costs, then there exists an equilibrium in which the sellers offer a variety of contracts with positive probability, which induces buyers to want to read, to be able to choose the best offer. A somewhat related conclusion is also reached by [63], who contend that if a sufficiently high fraction of consumers are "informed" about the various prices that sellers offer, then sellers will be induced to offer competitive prices, with positive probability, which will have an effect on the search strategies of "uninformed" consumers. Also, [3] analyze a standard, Rubenstein-type, alternating-offers bargaining game with complete information in which two parties engaged in a bilateral monopoly must pay costs in order to negotiate in any particular round. [3] determine conditions under which parties do indeed pay the costs

of negotiation: the key condition relates the joint negotiation costs to the players' impatience; however, the correspondence between reading costs as presented in this paper and negotiation costs is not exact. Preliminary work on a model where a buyer who faces contract-reading costs may receive a sequence of offers over time, and even may have the opportunity to **retain** offers for a number of periods, suggests that reading costs still will not be incurred in equilibrium. So, it seems that, absent a particularly strong form of competition, such as the Bertrand-style simultaneous competition studied in Chapter II, the conclusion that buyers will not invest to read contracts is in fact somewhat general. To conclude, notice that, if reading costs are never incurred, then legal doctrines that aim to reduce reading costs might end up being inefficient. But, if a contract equilibrium is being played in which consumers do invest positive amounts to read, as is the case in the *RCM* of Chapter II (or to search, as in [63]) then controlling reading costs is critical.

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