Selling with Evidence*

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June 30, 2016

Abstract

We consider a seller who can propose any selling mechanism to a buyer. The seller’s reservation value and the buyer’s valuation can depend both on the buyer’s privately-known taste and on product characteristics privately-known to the seller. Product information is voluntarily and costlessly certifiable by the seller. We characterize all feasible allocations under any certifiability structure and formulate the informed-principal mechanism-proposal game. When product characteristic is perfectly certifiable we show that there is an ex-ante profit-maximizing selling procedure that is an equilibrium of the mechanism-proposal game. In contrast to the case where the seller can only post prices, information unravelling of product characteristics fails even when all buyer types agree on the ranking of product quality.

Keywords: Informed principal; consumer heterogeneity; interdependent valuations; product information disclosure; mechanism design; certification.

JEL Classification: C72; D82.

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*We thank the French National Research Agency (ANR) for financial support. We thank Philippe Jehiel, Laurent Lamy, Thomas Mariotti and Roland Strausz for useful comments.

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1 Introduction

Virtually all firms and businesses have superior information about their products and services vis-a-vis their customers. In a seminal paper Akerlof (1970) shows that, in such asymmetric information instances, perceived average quality drives the market price which leads to market failure, since sellers of high-quality products are unwilling to sell at such a price. What if sellers can certify their quality? Sellers often offer hard information to their customers in the form of free samples, trial periods, review copies, third-party labels or stamps of approval. Viscusi (1978) first argues that when certification is possible, it is high-quality sellers who drive the market, since they have the biggest incentive to certify and to receive a high price. This market force leads to the well-known unravelling of information which—in the absence of other distortions—renders mandatory disclosure rules unnecessary.¹

What happens when an informed seller can not only certify, but also employ more sophisticated selling procedures compared to simply posting a price? This paper answers this question. We consider a privately informed seller facing a buyer who has private information about his taste. Values are interdependent, so the seller’s reservation value or cost and the buyer’s valuation can depend both on the buyer’s taste and on product characteristics. The seller knowing his information can provide evidence (certify information) about product characteristics and can choose any selling procedure: a fixed price, an information fee followed by an acquisition fee, or any other sales contract, which we model as a mediated selling mechanism. This is the first paper to analyze an informed-principal problem with certifiable information for the principal and private (non-certifiable) information for the agent. We make no assumptions on how the seller’s reservation value and the buyer’s valuation depend on the type profile.

We describe a canonical certification and communication protocol and characterize all feasible selling outcomes (allocations) as a function of the seller’s certification abilities. We formulate the informed-principal mechanism-proposal game where the seller chooses any selling procedure at the interim stage (i.e., knowing his information). We establish that under own-type certifiability, there is always an ex-ante profit-maximizing selling procedure that is an equilibrium of the mechanism-proposal game. This result implies that the seller does not benefit from being able to commit even to the best—in terms of profit—mechanism before knowing his type. This is surprising, since, even if there is a highest quality seller type,² he still does not benefit by deviating from this mechanism. Perhaps, more surprising is that we show that unravelling of information (which is associated with lower ex-ante profits for the seller compared to our equilibrium profit) may not be an equilibrium outcome, even when all buyer types agree on the

¹There is an extensive theoretical and empirical literature that studies certification and disclosure by firms. See the surveys by Dranove and Jin (2010) and Milgrom (2008) and references therein.

²Our model allows the characteristics known to the seller to be arbitrary which, of course, includes “vertical” features.
ranking of seller types and it is the unique equilibrium outcome under price-posting. Under some further assumptions, we show that all equilibrium outcomes are ex-ante profit-maximizing.

Consider the Pareto frontier of interim seller profits that can arise from any feasible mechanism as we vary beliefs. A frontier point exists for all priors, and we establish that the expectation of these interim profits is equal to the ex-ante maximal profit (the best that the seller can achieve when he chooses the mechanism before knowing his type). Our main theorem establishes that the Pareto frontier profit vector for the prior is an equilibrium outcome of the mechanism-selection game. This frontier is precisely what Maskin and Tirole (1990) define as the set of SUPO (strong-unconstrained Pareto outcomes) and existence follows from analogous arguments as in their work. To prove the theorem we establish that for each conceivable deviation, there exist beliefs and an equilibrium outcome (of the deviation) given these beliefs that is not better for any type of the seller. And the fact that mechanisms are general implies that a priori there is no belief that works for all deviations: off-path beliefs must be carefully chosen to render a deviation unprofitable, as well as the off-path strategies given these beliefs.

The ability of the seller to certify his information enlarges the set of feasible allocations since now types that cannot offer the same evidence cannot mimic each-other. In other words, certifiability relaxes the seller’s incentive compatibility constraints. At the same time, the ability to certify makes deviations more effective: A high quality seller, for example, can deviate from a selling procedure by providing evidence of his quality and by asking a high price. This force implies a necessary condition for equilibrium outcomes: When each type can fully certify (own-type certifiability), no seller type can obtain an equilibrium profit below what he can guarantee by providing full certification, which equals the profit under the “full-information” revenue-maximizing mechanism. Moreover, despite the bilateral asymmetric information, interdependent values, and the fact that an informed party has all the bargaining power, the outcome is on the profit Pareto frontier. Flexibility in choosing the selling contract enables the seller to leverage his superior information vis-a-vis the buyer to increase his profits compared to the unravelling case both relative to the interim and the ex-ante perspective.

The economic nature of our results is quite distinct from the existing ones in the most closely related literatures of selling with certifiable information and that of informed principal. The unravelling outcome may not be an equilibrium even though it is the unique equilibrium outcome when the seller’s information is certifiable but he can only choose prices (Koessler and Renault, 2012). Maskin and Tirole (1990) analyse a private-value model where the principal’s information is “soft” (not certifiable) and establish that in a quasilinear setup, as is ours, the unique equilibrium outcome is the “full-information” one. Maskin and Tirole (1992) analyze a common value setup where the principal’s information is soft and establish that equilibrium

\[3\text{This terminology is introduced in Maskin and Tirole (1990) and refers only to complete information about the seller’s type, not the buyer’s.}\]
outcomes (when they exist) need not be on the Pareto frontier.

The inefficiencies caused by having an informed party choose the selling procedure is the focus of De Clippel and Minelli (2004) who study a bargaining problem with bilateral asymmetric information and without transfer. The allocation (a mapping from types to a vector of payoffs) is chosen by one of the informed parties at the interim stage, but types are verifiable at the time of implementation, so it is as if the seller and the buyer are required to fully certify their type. Focusing, then, on a game protocol in which a proposed allocation is either accepted or rejected by the other party, they characterize the set of equilibrium outcomes allowing both parties to have some power to make a proposal.

To establish our results we rely on the general formulation of the informed principal problem of Myerson (1983) and extend it to allow the principal’s information to be certifiable. Perhaps surprisingly, key methodological insights developed by Maskin and Tirole (1990) for a private-value setup with soft information have useful counterparts in our setup. Following the tradition of mechanism design with certifiable information (Green and Laffont, 1986,Forges and Koessler, 2005, Bull and Watson, 2007, Deneckere and Severinov, 2008, and Strausz, 2016), we take the certification structure as exogenous and taking it as a primitive, we find equilibrium selling procedures chosen by such an informed seller.4 The advertising literature, see, for example, Johnson and Myatt (2006) and Anderson and Renault (2006),5 assumes that the firm is not privately informed when it designs (and commits to) its information disclosure rule. Sun (2011) and Koessler and Renault (2012) relax this and study information disclosure by an informed firm at the interim stage, but, unlike this paper, focus on posted prices. Our results complement those, by demonstrating that when full certification of product characteristics is possible, there exists an ex-ante optimal selling procedure6 that is an equilibrium when the firm makes the choice knowing its type.

2 Motivating Example

To get a flavor of the setup and the results, consider a seller, whose good can be one of two types \( \{s_1, s_2\} \), facing a single buyer whose taste is equally likely to be \( t_1 \) or \( t_2 \) and whose valuation

4Most mechanism design literature assumes that the information structure is exogenous and the assumption that certification abilities are exogenous is in the same spirit. It captures well that, often, in reality the structure of available certificates is exogenous—takes the form of hygiene letter grades (A,B,C . . . ) for restaurants or multi-letter grades (AAA, AA+, BBB . . . ) for ratings of financial assets. Restaurants choose whether or not to reveal their certificate. Similarly, asset issuers can selectively disclose ratings. In this paper the seller decides what evidence to provide to the mechanism.

5See Renault, 2016, Section 3, for a comprehensive literature review.

6The procedure bundles information release with the terms of sale.
for the product is described in the following matrix:

\[
\begin{array}{c|cc}
  & t_1 & t_2 \\
 s_1 & 5 & 3 \\
 s_2 & 1 & 2 \\
\end{array}
\]

In this example the seller only cares about revenue and can certify quality at no cost. Observe that \( s_1 \) is the high quality product, while a \( t_1 \) consumer values quality more than \( t_2 \). When the consumer knows whether the product is \( s_1 \) or \( s_2 \), the profit-maximizing selling procedure is for \( s_1 \) to ask a price of 3 and for \( s_2 \) to ask a price of 1, yielding interim profits \( (V(s_1), V(s_2)) = (3, 1) \)--this is the full-information outcome.

As mentioned in the introduction, Koessler and Renault (2012) establish that when the buyer’s valuation function is “pairwise monotonic”--as is the case in this example--unravelling forces make \( (V(s_1), V(s_2)) = (3, 1) \) the unique equilibrium revenue with certifiable information and posted prices. When the seller cannot certify (information is “soft”), but can employ any selling procedure, Koessler and Skreta (2016) show that there is a continuum of equilibrium interim profit vectors described by the line segment that coincides with the 45-degree line, between the “best safe” revenue (which is 1 and independent of the prior) and the ex-ante optimal revenue which depends on the prior about the seller’s type (it varies from 1 when the belief is \( \pi(s_1) = 0 \), to 3 when \( \pi(s_1) = 1 \)). For instance, when \( \pi(s_1) = \frac{1}{2} \) the set of equilibrium interim profit vectors is the line segment connecting \((1, 1)\) and \((2.5, 2.5)\). So what are the equilibrium profits when the seller’s information is certifiable and he can employ any general selling procedure?

**Unique Equilibrium with Certifiable Information:** We show that when \( \pi(s_1) > \frac{1}{3} \) the unique equilibrium profit vector with certifiable information and general selling mechanisms is \( (V(s_1), V(s_2)) = (3, 2) > (3, 1) \). Despite the fact that the valuation function is monotonic, the unravelling outcome is not an equilibrium. Ex-ante, as well as interim profits are higher compared to the
case in which the seller does not have private information. In fact, the equilibrium outcome is ex-ante profit-maximizing and cannot be achieved with posted prices. When the prior is \( \pi(s_1) < \frac{1}{3} \), the unique equilibrium profit vector is \((V(s_1), V(s_2)) = (5, 1)\). The comparison of \((3, 2)\) with \((5, 1)\) illustrates that, when information is certifiable, the high quality seller \((s_1)\) can be strictly better-off when the consumer thinks that the seller is more likely to have low quality \((s_2)\)!

This is in contrast to the case when the seller’s information is soft, in which, as we saw, the best equilibrium profit increases in the probability that the seller’s type is high.

**Implementation:** To achieve the outcome \((3, 2)\) the seller proposes an “evidence-conditional” contract: If the buyer accepts the contract, he has to pay a price of 3 if the seller presents the evidence \(s_1\) and otherwise a price of 2. The buyer is willing to accept this contract because he does know whether he will face a price of 3 or a price of 2 and for both of his types the expected payment of 2.5 exceeds the expected valuation of the good. This contract implements the following allocation

\[
(p, x)(s, t) = \begin{array}{cc}
  & t_1 & t_2 \\
 s_1 & 1, 3 & 1, 3 \\
 s_2 & 1, 2 & 1, 2
\end{array}
\]

where \(p\) is the probability of trade and \(x\) is the expected payment as a function of each type profile \((s, t)\). Note that this profit-maximizing allocation is ex-post efficient.\(^7\)

### 3 Setting and Definitions

#### 3.1 The Trading Problem

Consider a monopoly seller with one indivisible good facing a single buyer with unit demand. The seller has perfect and private information about the product’s characteristics, denoted by \(s \in S\) and also called the type of the seller. The buyer has perfect and private information about his taste, denoted by \(t \in T\) and also called the type of the buyer. The type space \(S \times T\) is finite and types are independently distributed, with strictly positive probability distributions \(\pi^0 \in \Delta(S)\) and \(\tau \in \Delta(T)\). The buyer’s valuation for the product is denoted by \(u(s, t) \in \mathbb{R}\). The seller’s reservation value is denoted by \(v(s, t) \in \mathbb{R}\).\(^8\)

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\(^7\)If \(u(s_2, t_1) = 0.999\) instead of \(u(s_2, t_1) = 1\), \((3, 2)\) is still the unique equilibrium outcome and efficient and \((3, 1)\) is still the unravelling outcome—however now \(s_2\) strictly prefers to ask a price of 2 and sell only to \(t_2\), which sacrifices efficiency for profit. The friction that causes this is that the buyer is also privately informed. So in the modified example, the unravelling outcome is less efficient compared to the ex-ante optimal equilibrium mechanism, however examples with the reverse feature are possible.

\(^8\)The reservation value \(v(s, t)\) could equivalently be interpreted as the constant marginal cost of the seller for delivering the good.
An allocation is given by \( p : S \times T \to [0, 1] \) and \( x : S \times T \to \mathbb{R} \), where \( p(s, t) \) is the probability of trade and \( x(s, t) \) is the transfer from the buyer to the seller. We assume that transfers lie in a compact and convex set: \( x(s, t) \in [-X, X] \) for every \( s \) and \( t \), where \( X \) is large.

Both the seller and the buyer are risk-neutral. Given an allocation \((p, x)\), the seller’s profit and the buyer’s utility are

\[
V(s, t) = x(s, t) - p(s, t)v(s, t), \quad \text{and} \quad U(s, t) = p(s, t)u(s, t) - x(s, t). \quad (1)
\]

Interim expected payoffs are

\[
V(s) \equiv \sum_{t \in T} \tau(t)V(s, t), \quad \text{and} \quad U(t) \equiv \sum_{s \in S} \pi^0(s)U(s, t). \quad (2)
\]

### 3.2 Mechanism-Proposal Game

We analyze an informed-principal game in which the seller selects a mechanism after he has learned his type. Such a mechanism specifies a probability of trade and a transfer as a function of (cheap talk) messages from the seller and the buyer. In addition to these standard messages, the seller is able to certify some information by providing evidence about product characteristics at no cost. This certification ability is exogenous and represented by a certifiability structure \( \mathcal{E} \subseteq 2^S \) which stands for the set of events that the seller is able to certify. Let \( \mathcal{E}(s) = \{ E \in \mathcal{E} : s \in E \} \) be the set of such events when the seller’s actual type is \( s \in S \). When information is not certifiable we have \( \mathcal{E}(s) = \{ S \} \) for every \( s \in S \).\(^9\) We assume that \( \mathcal{E}(s) \neq \emptyset \) for every \( s \in S \). Following Forges and Koessler (2005), we also assume that \( \mathcal{E} \) is closed under intersection,\(^10\) which means that each seller \( s \) has the ability to certify as many events in \( \mathcal{E}(s) \) as he wants. We say that the certifiability structure satisfies own type certifiability if \( \{ s \} \in \mathcal{E} \) for every \( s \in S \).

The timing of the Mechanism-Proposal Game is as follows:

1. Nature selects the seller’s type, \( s \in S \), according to the probability distribution \( \pi^0 \in \Delta(S) \), and the buyer’s type, \( t \in T \), according to the probability distribution \( \tau \in \Delta(T) \);

2. The seller is privately informed about \( s \in S \) and the buyer is privately informed about \( t \in T \);

3. The seller proposes a mechanism, consisting of (finite) sets of cheap talk messages \( M_S \) for

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\(^9\)Using a certifiability structure is equivalent to using any abstract message correspondence \( Z : S \Rightarrow Z \) by letting \( \mathcal{E}(s) = \{ Z^{-1}(z) : z \in Z(s) \} \). The set \( Z^{-1}(z) \) is the set of seller types who can send message \( z \), so \( Z^{-1}(z) \) is the event that message \( z \) certifies.

\(^{10}\)This property is called “minimal closure condition” in Forges and Koessler (2005) and “normality” in Bull and Watson (2007).
the seller and $M_T$ for the buyer, and a function

$$\mathcal{M} : \mathcal{E} \times M_S \times M_T \rightarrow [0, 1] \times \mathbb{R},$$

which specifies a probability of trade and a selling price as a function of the event $E \in \mathcal{E}$ certified by the seller, the cheap talk message $m_S \in M_S$ of the seller and the cheap talk message $m_T \in M_T$ of the buyer.

4. The seller and buyer observe a uniformly distributed public signal in $[0, 1]$.\textsuperscript{11} The seller certifies an event $E \in \mathcal{E}$ and submits a cheap talk message $m_S \in M_S$ to the mechanism. Simultaneously, the buyer decides to reject the mechanism or to accept the mechanism and sends a message $m_T \in M_T$ to the mechanism.

The mechanism $\mathcal{M}$ and the reporting and participation strategies implement an allocation $(p, x)$. The default allocation of no trade and no payment arises if the buyer rejects, in which case both players’ payoff is zero.

An allocation $(p, x)$ is \textit{feasible} is there exists a mechanism $\mathcal{M}$, and reporting and participation strategies that implement the outcome $(p, x)$ and form a Nash equilibrium given $\mathcal{M}$. An allocation $(p, x)$ is an \textit{expectational equilibrium} (Myerson, 1983) iff it is \textit{feasible} and no type of seller can benefit from deviating to any mechanism: for every deviation to a mechanism $\tilde{\mathcal{M}}$, there exists a belief $\tilde{\pi} \in \Delta(S)$ for the buyer, reporting and participation strategies that form a continuation Nash equilibrium given $\tilde{\mathcal{M}}$ and $\tilde{\pi}$, with outcome $(\tilde{p}, \tilde{x})$, such that $V(s) \geq \tilde{V}(s)$ for every $s \in S$.\textsuperscript{12}

Our goal is to characterize equilibrium outcomes of this game. In order to do that we first characterize feasible allocations and then identify those who are immune to deviations.

### 3.3 Feasible Allocations

To characterize feasible allocations, we follow the revelation principle in Forges and Koessler (2005). Let $E^*(s) = \bigcap_{E \in \mathcal{E}(s)} E$ be the smallest event that the seller is able to certify when his actual type is $s$. The fact that $\mathcal{E}$ is closed under intersection insures that $E^*(s)$ is certifiable by the seller when his type is $s$, i.e., $E^*(s) \in \mathcal{E}(s)$.

From the certifiability structure $\mathcal{E}$ we uniquely define the \textit{reporting correspondence} of the

\textsuperscript{11}This is to ensure convexity of the continuation equilibrium profits given $\mathcal{M}$, which is used in the proof of Theorem 1.

\textsuperscript{12}By the inscrutability principle (see Myerson, 1983), an expectational equilibrium is equivalent to the strong version of Perfect Bayesian Equilibrium which imposes that all buyer types have the same off-path beliefs after a deviation (recall, that we assume that types are independently distributed).
seller as \( R: S \rightarrow S \), with
\[
R(s) \equiv \{ \tilde{s} \in S : E^*(\tilde{s}) \in \mathcal{E}(s) \}.
\]
The set \( R(s) \) represents all seller types in \( S \) that type \( s \) is able to mimic when these types certify all information they can.\(^{13}\)

The following Proposition uses the revelation principle with partially certifiable types to characterize all feasible allocations in a canonical way. It is similar to the revelation principle without certifiable information, with the exception that each player (the seller and the buyer) is not only required to send a truthful cheap talk claim to the mechanism, but the seller is also required to certify as much information as he can about his type; that is, the buyer and the seller each privately make a truthful report about their type \( t \) and \( s \) respectively, and, in addition, the seller provides maximal evidence by privately certifying \( E^*(s) \) to the mechanism. For a given allocation \((p, x)\), let
\[
V(s' | s) \equiv \sum_{t \in T} \tau(t)(x(s', t) - p(s', t)v(s, t))
\]
be the seller’s interim expected profit when his type is \( s \) but gets the allocation of \( s' \), and
\[
U(t' | t) \equiv \sum_{s \in S} \pi^0(s)(p(s, t')u(s, t) - x(s, t'))
\]
be the buyer’s interim expected utility when his actual type is \( t \) but gets the allocation of \( t' \).

**Proposition 1** An allocation \((p, x)\) is feasible given the certifiability structure \( \mathcal{E} \) if and only if the following incentive compatibility and participation constraints are satisfied:
\[
\begin{align*}
V(s) & \geq V(s' | s), \text{ for every } s \in S \text{ and } s' \in R(s); \quad \text{(S-IC)} \\
V(s) & \geq 0, \text{ for every } s \in S; \quad \text{(S-PC)} \\
U(t) & \geq U(t' | t), \text{ for every } t, t' \in T; \quad \text{(B-IC)} \\
U(t) & \geq 0, \text{ for every } t \in T. \quad \text{(B-PC)}
\end{align*}
\]

**Proof.** The proof directly follows the revelation principle with partially certifiable types in Forges and Koessler (2005).\(^{14}\) \qed

This proposition implies that the set of feasible allocations is the same for all certifiability structures that are associated with the same reporting correspondence \( R \). This observation implies that the set of feasible allocations is the same under any certifiability structure satisfying own-type certifiability. Note that, under own-type certifiability, we have \( R(s) = \{ s \} \) so there is no informational incentive constraint for the seller, i.e., (S-IC) is always satisfied.

\(^{13}\)Note that \( s \in R(s) \) and that \( R \) satisfies the nested range condition of Green and Laffont (1986): \( s' \in R(s) \Rightarrow R(s') \subseteq R(s) \).

\(^{14}\)See also Green and Laffont (1986), Bull and Watson (2007), Deneckere and Severinov (2008), or Strausz (2016) for similar versions of the revelation principle.
Compared to the standard setting without certifiable information, certifiability extends the set of feasible mechanisms because it relaxes the seller’s incentive constraints. But it also extends the set of possible deviations from a given allocation \((p, x)\): when the seller deviates he can provide evidence of the type deviating (this ability drives the unravelling result under posted prices).

### 3.4 Ex-Ante and Full-Information Optimal Allocations

Before proceeding with equilibrium analysis, we define two benchmarks against which we compare equilibrium outcomes.

**Definition 1** An allocation \((p, x)\) is **ex-ante optimal** if it maximizes the ex-ante expected profit \(\sum_{s \in S} \pi^0(s)V(s)\) under the incentive compatibility and participation constraints \((S-IC)\), \((S-PC)\), \((B-IC)\) and \((B-PC)\).

**Definition 2** An allocation \((p, x)\) is **full-information optimal** if for every \(s \in S\) it maximizes the interim profit \(V(s)\) under the following ex-post incentive compatibility and participation constraints of the buyer:

\[
U(s, t) \geq p(s, t')u(s, t) - x(s, t'), \text{ for every } t, t' \in T; \tag{3}
\]
\[
U(s, t) \geq 0, \text{ for every } t \in T. \tag{4}
\]

In other words, an ex-ante optimal allocation results from a profit-maximizing mechanism chosen by the seller before learning his type, while a full-information optimal allocation results from profit-maximizing mechanisms chosen by the seller when his type is commonly known. The corresponding ex-ante (interim) profit is called the **ex-ante optimal** and **full-information ex-ante (interim) profit**.

Note that a full-information optimal allocation does not depend on the certifiability structure and, in general, there is no reason for such an allocation to be feasible. However, it is clearly feasible under own-type certifiability. Note also that if \(v(s, t)\) does not depend on \(t\), then (one of) the full-information optimal allocation is simply a posted price (see Myerson, 1981; Riley and Zeckhauser, 1983). Finally, note that if a full-information optimal allocation is feasible, then it is feasible whatever the belief of the buyer: it is **safe** according to the terminology of Myerson (1983).
4 Finding Equilibria

4.1 Simple Illustration

To get a sense of how to show that an allocation is an expectational equilibrium consider the following trivial example: The buyer has no private information and his valuation is 0 regardless of the seller’s type. The seller has two equally likely types \( s_1 \) and \( s_2 \) that he must fully certify \((E = \{\{s_1\}, \{s_2\}\})\), and a reservation value of zero. Obviously, if there is an equilibrium in this example it should give both seller types zero.\(^{15}\) To show that there exists such an equilibrium, we have to demonstrate that no matter what mechanism the seller deviates to, there exists a belief of the buyer and an equilibrium play given this belief, that results in a vector of interim profits that it is not preferred by any type of the seller compared to (0,0).

Consider a deviation to following mechanism where the buyer has only one message \((M_T = \{t_1\})\):

\[
\mathcal{M}^{\text{direct}}(s, t) = \begin{array}{c|c|c}
\hline
& t_1 \\
\hline
\{s_1\} & p_1, x_1 \\
\{s_2\} & p_2, x_2 \\
\hline
\end{array}
\]

The buyer either accepts or rejects such a deviation. It is easy to see there is a range of beliefs that supports the equilibrium outcome (0,0): For example, if \(x_1, x_2 > 0\), then the buyer rejects the direct mechanism regardless of his beliefs; if \(x_1, x_2 < 0\), then the buyer accepts whatever his belief, but the profit of the seller is negative whatever his type; if \(x_1 > 0\) but \(x_2 < 0\) \((x_1 < 0\) but \(x_2 > 0\), respectively), then the buyer rejects if he believes that it is sufficiently likely that the seller’s type is \(s_1\) \((s_2\), respectively).

Now consider the situation in which the seller deviates to the following mechanism, where the set of messages for the buyer is \(M_T = \{\text{Left}, \text{Right}\}\):\(^{16}\)

\[
\mathcal{M}^{\text{LR}} = \begin{array}{c|c|c}
\hline
& \text{Left} & \text{Right} \\
\hline
\{s_1\} & \{p_1L, x_1L\} & \{p_1R, x_1R\} \\
\{s_2\} & \{p_2L, x_2L\} & \{p_2R, x_2R\} \\
\hline
\end{array}
\]

Let \(\pi\) be the belief of the buyer on type \(s_1\). If, for example, \(x_1L = x_2R = -x_1R = -x_2L = x > 0\), then the buyer never rejects whatever his belief: he chooses Right if \(\pi > 1/2\) and Left if \(\pi < 1/2\). The deviation is therefore strictly profitable for seller type \(s_2\) if \(\pi > 1/2\), and for seller type \(s_1\) if \(\pi < 1/2\). To make the deviation not profitable for any seller type, the buyer’s

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\(^{15}\)The arguments below used to show that (0,0) is indeed an equilibrium can be extended to any situation in which full-surplus extraction by the seller is feasible.

\(^{16}\)The arguments extend to any number of messages.
belief should be exactly $\pi = 1/2$, in which case he is indifferent between Left and Right and he should randomize equally between the two messages, so that the seller’s interim profit is $rac{1}{2}(x, -x) + \frac{1}{2}(-x, x) = (0, 0)$.

More generally, to find a belief and reporting strategy that deter deviation to any mechanism $M^{LR}$, consider the auxiliary zero-sum game

$$\begin{pmatrix} x_{1L} & x_{1R} \\ x_{2L} & x_{2R} \end{pmatrix},$$

and let $\phi$ be the value of this game. Using basic properties of zero-sum games, it is immediate to conclude that, if $\phi \geq 0$, then there exists $\pi$ such that the buyer rejects; likewise, if $\phi < 0$, then there exists $\pi$ and an optimal reporting strategy for the buyer such that the seller’s interim profit is lower than $\phi$ for every $s$.

Figure 1 illustrates a few lines of interim profits achievable by various mechanisms as we vary the buyer’s belief $\pi$. Because the buyer’s valuation is zero and he can always reject, we cannot achieve strictly positive vectors of profits. The upper contour set of all achievable interim profits is represented in bold red as a function of the belief $\pi$. The next subsection defines this Pareto optimal frontier set in general, and shows that a point on this frontier for the prior $\pi^0$ always exists, is ex-ante optimal for the seller, and always correspond to an equilibrium outcome of the mechanism-selection game.
4.2 General Analysis and Results

In the general analysis that follows we first define the Pareto frontier of all feasible interim profits achievable as the buyer’s belief vary; second, we establish that on this frontier there is a point that is feasible for the prior; third, we show this point is ex-ante optimal for the seller; finally, we show that it corresponds to an equilibrium outcome of the mechanism-selection game.

For every \( \pi \in \Delta(S) \), let

\[
U_\pi(t) \equiv \sum_{s \in S} \pi(s)U(s, t),
\]

and

\[
U_\pi(t' | t) \equiv \sum_{s \in S} \pi(s)(p(s, t')u(s, t) - x(s, t')).
\]

**Definition 3** An allocation \((p, x)\) is a Pareto Optimum (PO) with belief \( \pi \in \Delta(S) \) if there exists \( w \in \Delta(S) \) such that \((p, x)\) maximizes \( \sum_{s \in S} w(s)V(s) \) under the interim incentive and participation constraints of the buyer given belief \( \pi \):

\[
U_\pi(t) \geq U_\pi(t' | t), \text{ for every } t, t' \in T; \tag{5}
\]

\[
U_\pi(t) \geq 0, \text{ for every } t \in T. \tag{6}
\]

A full-information allocation is always a PO with degenerate beliefs \((w(s) = \pi(s) = 1 \text{ for some } s \in S)\). Also, under own-type certifiability an ex-ante optimal allocation is a PO with belief \( \pi = \pi^0 \) and weights \( w = \pi^0 \).

Let \( V^{PO}(\pi) \subseteq \mathbb{R}^{|S|} \) be the set of Pareto optimal interim profits with belief \( \pi \in \Delta(S) \) and \( V^{PO} = \bigcup_{\pi \in \Delta(S)} V^{PO}(\pi) \) the set of all Pareto optimal interim profits.

**Definition 4** The set of strong Pareto optimal interim profits, denoted by \( V^{SPO} \), is the set of Pareto optimal interim profits \( V^* \in V^{PO} \) such that (i) there is no \( \pi \in \Delta(S) \), \( V \in V^{PO}(\pi) \) such that \( V \) strictly Pareto dominates \( V^* \), and (ii) there is no \( \pi \in \text{int} \Delta(S) \), \( V \in V^{PO}(\pi) \) such that \( V \) Pareto dominates \( V^* \).

That is, \( V^{SPO} \) is the outer envelope of the interim PO profits locus as beliefs vary. Let \( V^{SPO}(\pi) \subseteq \mathbb{R}^{|S|} \) be the set of strong Pareto optimal interim profits with belief \( \pi \in \Delta(S) \).

In the previous trivial example with a single buyer type and zero valuations and reservation values \((V_1, V_2)\) is a PO interim profit vector if and only if it maximizes \( wV_1 + (1 - w)V_2 \) under the constraint \( \pi V_1 + (1 - \pi)V_2 = 0 \) for some \( w, \pi \in [0, 1] \). This yields \( V^{PO} = ([-\mathcal{X}, 0] \times [0, \mathcal{X}]) \cup ([0, \mathcal{X}] \times [-\mathcal{X}, 0]) \). The PO interim profits \((0, 0)\) are obtained with \( \pi = w = 1/2 \), while the PO profits on the segments \([(0, 0) - (0, \mathcal{X})]\) and \([(0, 0) - (\mathcal{X}, 0)]\) are obtained only with extremal
beliefs \( \pi = 1 \) and \( \pi = 0 \) respectively. Hence, \( \mathcal{V}^{SPO} = \{((0, 0), [(0, 0) - (0, \mathcal{X})], [(0, 0) - (\mathcal{X}, 0)]\}, \) and the only SPO profits with interior beliefs are \((0, 0)\).

**Example 1 (5312 Example)** In the introductory example, the PO interim profits are given by the dashed grey area in Figure 2. The SPO interim profits are the red segments going through the points \((\mathcal{X}, 1)\), \((5, 1)\), \((3, 2)\) and \((3, \mathcal{X})\). The only SPO profits with interior beliefs are points on the segment \([(5, 1) - (3, 2)]\), obtained with \(\pi = 1/3\). Note that, among the SPO profits, only \((3, 2)\) is feasible for the prior. Interestingly, the full-information vector of interim profits \((3, 1)\) is not SPO, and \((4, 1)\) is an ex-ante optimal vector of interim profits, it is above the full-information profits, but it is not SPO.

![Figure 2: PO and SPO in the 5312 Example](image)

**Remark 1** The definitions of PO and SPO profits have been introduced by Maskin and Tirole (1990) (they call them (strong) unconstrained Pareto optimal profits). They showed that SPO profits are equilibrium profits under private-values and soft information. They also established that, under the additional assumption of quasi-linear utilities, the set of SPO profits is the same singleton for all interior beliefs and it coincides with the full information profits (no benefit of information privacy for the seller). This is not the case in our setup as the previous example illustrates.

**Proposition 2** There exists at least one SPO for every \(\pi^0 \in \Delta(S)\).
Proof. The proof follows from Maskin and Tirole (1990) by defining a fictitious competitive economy in which the seller’s types are trading slacks for the ex-post incentive compatibility and participation constraints of the buyer. Existence of a Walrasian equilibrium relative to $\pi^0$ in such an economy follows from standard arguments in general equilibrium theory, see Maskin and Tirole (1990) for details. In this paper we have interdependent values. Still, the Walrasian equilibrium allocation can be shown to be SPO.\footnote{This follows by straightforwardly extending the corresponding arguments in Maskin and Tirole (1990). Full details are available from the authors upon request.}

The next Proposition establishes that a SPO allocation for the prior is ex-ante profit-maximizing for the seller. However, as we have seen in the leading example only one ex-ante profit maximizing vector for the prior is SPO (recall that the profit vectors $(4, 1)$ and $(2.5, 2.5)$ are ex-ante optimal but not SPO). This result does not appear in Maskin and Tirole (1990), and the proof uses the fact that we assume that utilities are quasi-linear (an assumption that is not made in Maskin and Tirole, 1990).

**Proposition 3** Every SPO allocation for the prior is ex-ante optimal.

**Proof.** Let $V(t) \equiv E_S V(s, t)$ and $V \equiv E_{T,S} V(s, t)$. To prove the Proposition, we show that if a vector of feasible profits $(\hat{V}(s))_{s \in S}$ is not ex-ante optimal then it is not SPO. Let $(p^*, x^*)$ be an ex-ante optimal allocation, with corresponding $(V^*(s))_{s \in S}$ and $V^*$. If $\hat{V}$ is not ex-ante optimal we have $V^* - \hat{V} > 0$. Let $S_1$ denote all seller types for which $\hat{V}(s) \geq V^*(s)$, and let $S_2$ be the complement of $S_1$. The set $S_2$ is non-empty because $\hat{V}$ is not ex-ante optimal.

Define an allocation $(\tilde{p}, \tilde{x})$ as follows:

$$\tilde{p}(s, t) = p^*(s, t) \text{ for all } s, t,$$

$$\tilde{x}(s, t) = \hat{V}(s) + p^*(s, t)v(s, t) \text{ for } s \in S_1, t \in T,$$

$$\tilde{x}(s, t) = \hat{V}(s) + p^*(s, t)v(s, t) + \frac{1}{\sum_{s' \in S_2} \pi^0(s')} \left[ V^*(t) - \hat{V} \right] \text{ for } s \in S_2, t \in T.$$

Note that:

$$\hat{V}(s, t) = \hat{V}(s) \text{ for } s \in S_1, t \in T,$$

$$\hat{V}(s, t) = \hat{V}(s) + \frac{1}{\sum_{s' \in S_2} \pi^0(s')} \left[ V^*(t) - \hat{V} \right] \text{ for } s \in S_2, t \in T.$$

The above two equations imply that $\hat{V}(s) = \hat{V}(s)$ for $s \in S_1$ and $\hat{V}(s) > \hat{V}(s)$ for $s \in S_2.$
because $V^* - \hat{V} > 0$. The interim payment of the buyer at the allocation $(\hat{p}, \hat{x})$ is

$$E_S[\hat{x}(s, t)] = E_S[\hat{V}(s) + p^*(s, t)v(s, t)] + \left[ V^*(t) - \hat{V} \right]$$

$$= E_S[p^*(s, t)v(s, t)] + V^*(t) = E_S[x^*(s, t)],$$

so the resulting allocation $(\hat{p}, \hat{x})$ is feasible because $(p^*, x^*)$ is. And it is better for all seller types, and strictly better those in $S_2$, compared to $(\hat{V}(s))_s$. Hence, $(\hat{V}(s))_s$ is not SPO. Contradiction.

\[ \blacksquare \]

**Theorem 1** Under own-type certifiability, every SPO allocation for the prior is an expectational equilibrium of the mechanism-proposal game.

**Proof.** Let $(\hat{p}, \hat{x})$ be a SPO allocation for the (strictly positive) prior belief $\pi^0 \in \Delta(S)$. Let $\hat{V} = (\hat{V}(s))_s \in \mathbb{R}^{|S|}$ denote the corresponding vector of interim profits.

We start by describing players’ strategies along the equilibrium path. Assume that all seller types propose the same direct revelation mechanism\(^{18}\)

$$\hat{M} : \mathcal{E} \times T \rightarrow [0, 1] \times \mathbb{R},$$

such that

$$\hat{M} = \begin{cases} (\hat{p}, \hat{x})(s, t) & \text{if } E = \{s\}, \\ (0, 0) & \text{otherwise.} \end{cases}$$

If the seller fully certifies his type and the buyer is truthful, then this mechanism implements the allocation $(\hat{p}, \hat{x})$. Since this proposal does not reveal any information about the seller’s information to the buyer, the buyer’s belief remains the prior after the proposal. Also, since, by assumption, $(\hat{p}, \hat{x})$ is feasible (because it is SPO for the prior), the buyer accepts $(\hat{p}, \hat{x})$ and reports his type truthfully, and the seller has no incentive to deviate from full certification (because this would result in no trade and zero profit).

To show that proposing $\hat{M}$ constitutes an expectational equilibrium we have to show that for any deviation to any generalized mechanism $M$, there exist off-path beliefs for the buyer $\pi^* \in \Delta(S)$ such that there is an equilibrium outcome of $M$ given these beliefs that yields an interim profit $V^*(s)$ for the seller type $s$ that is not better than $\hat{V}(s)$ for every $s$. Since the continuation game induced by $\hat{M}$ (and the public signal) is finite, $\hat{M}$ has at least one continuation equilibrium for any off-path belief $\pi \in \Delta(S)$. Let $V(\pi)$ be the convex hull of the

\(^{18}\)The corresponding set of cheap talk messages for the buyer is $\hat{M}_T = T$ and the set of cheap talk messages for the seller is a singleton. Notice that $\{s\} \in \hat{E}$ for every $s \in S$ because we assume own-type certifiability.
set of equilibrium profits of the principal when off-path beliefs are $\pi$.\(^{19}\) Let $V \subseteq \mathbb{R}_{+}^{|S|}$ be the convex hull of $\bigcup_{\pi \in \Delta(S)} V(\pi)$.

For every profit vector $V = (V(s))_{s \in S} \in V$ and belief $\pi \in \Delta(S)$ define the correspondence $(\pi, V) \rightarrow \arg \max_{\tilde{\pi}} \sum_{s \in S} \tilde{\pi}(s)(V(s) - \hat{V}(s)) \times V(\tilde{\pi})$. \hfill (7)

The cross product of the belief and the profit sets, $\Delta(S) \times V$, is convex and compact, and the correspondence is upper hemi-continuous and convex valued, so from Kakutani’s fixed point theorem it has a fixed point $(\pi^*, V^*) \in \Delta(S) \times V$. That is, there exists $(\pi^*, V^*)$ is such that $\pi^* \in \arg \max_{\pi} \sum_{s \in S} \pi(s)(V^*(s) - \hat{V}(s))$ and $V^* \in V(\pi^*)$.

After any deviation to a mechanism $M$, consider such an off-path belief $\pi^*$ for the buyer, and the corresponding continuation equilibrium profit vector $V^*$. Let $I = \{s : V^*(s) > \hat{V}(s)\}$ and $J = \{s : V^*(s) \leq \hat{V}(s)\}$. First observe that $I \neq S$ because $\hat{V}$ is SPO. Assume by way of contradiction that $I$ is nonempty; then $\pi^*_s = 0$ for all $s \in J$ because $\pi^*$ maximizes $\sum \pi(s)(V^*(s) - \hat{V}(s))$. Since $V^*$ is a continuation equilibrium profit given $\pi^*$, it is feasible given $\pi^*$. Hence the vector of interim profits $\tilde{V}$ with $\tilde{V}(s) = V^*(s)$ for $s \in I$ and $\tilde{V}(s) = \hat{V}(s) + \varepsilon > V(s)$ for $s \in J$ is also feasible given $\pi^*$. This implies that $\tilde{V}$ strictly Pareto dominates $\hat{V}$, and therefore $\tilde{V}$ is not SPO, a contradiction. Thus, $I = \emptyset$, which means that $V^*$ is not profitable compared to $\hat{V}$ for any seller type $s$.

The proof of Theorem 1 uses the same correspondence as the proof of Proposition 6 in Maskin and Tirole (1990).

**Corollary 1** Under own-type certifiability, there exists an ex-ante profit maximizing expectational equilibrium.

**Proof.** Directly from Propositions 2, 3 and Theorem 1. \hfill ■

## 5 Extensions

**Are all equilibria optimal?** We have shown that being SPO is a sufficient condition for a vector of interim profits to constitute an equilibrium outcome of the mechanism-proposal game. We have also shown that it is ex-ante optimal. If the seller were able to choose a mechanism before learning his type, he would clearly choose an ex-ante optimal mechanism. Hence, a SPO allocation has the strong property that it can be optimally chosen at the ex-ante stage, and

\(^{19}\)In case of multiple equilibria, the random public signal observed by the seller and buyer before they play the mechanism $M$ selects one.
it is immune to deviations by the seller at the interim stage. But are there other equilibria of
the mechanism-selection game that are not ex-ante optimal? We argue below that being SPO
(and, therefore, ex-ante optimal by Proposition 3) is also a necessary equilibrium condition, at
least if we extend the set of allowable mechanisms as in Maskin and Tirole (1990) by adding
a “dummy agent” who can send messages to the mechanism, and if we make a tie-breaking
assumption for the buyer.\(^\text{20}\)

Consider first the introductory example, for which we are able to show below that the SPO
allocation is the unique equilibrium, without making additional assumptions. We know from
Theorem 1 that \((3, 2)\) is a vector of interim equilibrium profits for the uniform prior. Consider
the mechanism \(\tilde{M}: \mathcal{E} \times M_S \times M_T \to [0, 1] \times \mathbb{R}\) where \(M_S\) is a singleton, \(M_T = \{\text{Left}, \text{Right}\}\)
and

\[
\tilde{M} = \begin{pmatrix}
\{s_1\} & \{s_2\} & \{s_1, s_2\} \\
1, 5 & 1, 3 & 1, -10 \\
1, 1 & 1, 2 & 1, -10 \\
\end{pmatrix}
\]

By varying the buyer’s beliefs, the mechanism \(\tilde{M}\) above generates all SPO interim profits
with interior beliefs. Hence, whatever the prior belief of the buyer, an equilibrium must be SPO.
\(^{20}\)Instead of this tie-breaking assumption one can alternatively make, as in Maskin and Tirole (1990), a sorting
assumption (see the proof of Proposition 7 in Maskin and Tirole, 1990).
We do not know if such a “canonical” and finite mechanism, generating the upper contour set of all feasible interim profits as beliefs vary, can be constructed in general. Therefore, to show that only SPO allocations can be equilibria in general, we extend the class of environments and mechanisms, and make additional assumptions.

**A1: (Dummy agent)** There is a dummy uninformed agent (for example, a second buyer with zero-valuation) who observes the mechanism proposed by the seller and is allowed to send messages in $\Delta(S)$ to the mechanism. A mechanism in this extended environment is therefore given by $\{\tilde{M}[\mu] : \mathcal{E} \times M_S \times M_T \to [0,1] \times \mathbb{R} : \mu \in \Delta(S)\}$.\(^{21}\)

**A2: (Tie-breaking rule)** If the seller proposes a direct mechanism (i.e., such that $M_T = T$), then, given any continuation reporting and participation strategy profile, the buyer reveals his type truthfully and participates if he has a weak incentive to do so.

**Proposition 4** Under own-type certifiability, A1 and A2, every expectation equilibrium allocation is a SPO allocation for the prior.

**Proof.** (Sketch) The idea of the proof is as in Maskin and Tirole (1990) but is easier because the seller’s type is certifiable. The seller chooses a mechanism $\{\tilde{M}[\mu] : \mu \in \Delta(S)\}$, where $\mu$ is the dummy agent’s report about the buyer’s belief, and $\tilde{M}[\mu]$ is a direct mechanism corresponding to a SPO allocation given $\mu$. The dummy agent is incentivized by the seller to report the true off-path belief $\pi \in \Delta(S)$ of the buyer after the mechanism $\{\tilde{M}[\mu] : \mu \in \Delta(S)\}$ has been proposed by using a proper scoring rule with arbitrary small rewards. This is possible because in (an expectational, or strong perfect Bayesian) equilibrium the dummy agent has the same belief as the buyer (remember that the buyer’s type $t$ is not correlated with the seller’s type $s$). Hence, when the buyer’s belief is $\pi$ he actually faces the mechanism $\tilde{M}[\pi]$. Together with the tie-breaking assumption, this implies that the buyer participates and reports his type truthfully. The continuation interim profits are SPO given $\pi$, which by definition dominate any other feasible allocation for at least one type of the seller. Hence, for any allocation that is not SPO, the deviation to the mechanism $\{\tilde{M}[\mu] : \mu \in \Delta(S)\}$ is strictly profitable for at least one seller type whatever the off-path belief of the buyer. Therefore an equilibrium allocation must be SPO for the prior.

Combined with Proposition 3, Proposition 4 implies that every equilibrium of the extended mechanism-proposal game is ex-ante optimal.

\(^{21}\)Note that a mechanism $\{\tilde{M}[\mu] : \mu \in \Delta(S)\}$ is not finite anymore. Hence, for the mechanism-proposal game to be well defined and consistent with the original mechanism-proposal game, one has also to assume, as in Maskin and Tirole (1990, Section 3.D.), that the seller is restricted to choose “admissible mechanisms”, i.e., mechanisms such that: (a) there exists a continuation equilibrium regardless of the buyer’s belief; (b) the SPO equilibrium outcome identified in Theorem 1 remains an equilibrium in the extended mechanism-proposal game.
Partial certifiability Without own-type certifiability, a SPO allocation may not be feasible. For example, in our motivating example, the feasible allocations with soft information ($E = \{S\}$) give the same interim profit to both seller types which is at most 2.5. The intersection of this set with the SPO set is empty. However, if the certifiability structure is given by $E = \{\{s_1, s_2\}, \{s_1\}\}$, then the SPO vector of interim profits $(3, 2)$ is feasible. The next Proposition shows that, if a SPO allocation for the prior is feasible under partial certifiability, then it remains an equilibrium of the mechanism-selection game under partial certifiability.

**Proposition 5** If a SPO allocation for the prior is feasible under the certifiability structure $E$, then it is an equilibrium of the mechanism-proposal game under $E$.

*Proof.* The proof is direct from the following simple observation. From Theorem 1, under full certifiability, i.e., if the certifiability structure is given by $E^F = 2^S$, a SPO allocation for the prior is an equilibrium of the mechanism selection game. Since $E \subseteq E^F$, the set of possible deviations (mechanisms) of the seller in the mechanism-proposal game under $E$ is strictly included in the set of possible deviations in the mechanism-proposal game under $E^F$. Since the SPO allocation is feasible under $E$, it remains an equilibrium under $E^F$.

While a SPO allocation which is feasible under partial certifiability is an equilibrium, it may not be the unique equilibrium under partial certifiability, and some equilibria may not be ex-ante optimal. That is, Proposition 4 does not extend to partial certifiability even when the SPO allocation for the prior remains feasible. In particular, in pure horizontal differentiation problems (when each seller type is ex-ante symmetric), there may be a continuum of equilibria when information is not certifiable (see Koessler and Skreta, 2016).

Information certification by the buyer In this paper we assumed that only the seller’s type is certifiable. When the buyer is privately informed about his taste for the different product types this is a reasonable assumption for many applications. What happens otherwise? If the seller and the buyer’s information is perfectly certifiable in our environment, equilibrium outcomes are trivial: The seller can extract all surplus in each state by proposing the allocation $(p, x)(s, t) = (0, 0)$ if $v(s, t) \geq u(s, t)$, and $(p, x)(s, t) = (1, u(s, t))$ if $v(s, t) < u(s, t)$. It is immediate to show that the resulting vector of interim profits is the unique equilibrium vector of interim profits.

A more general bargaining environment with full certifiability from the principal and the agent has been studied by De Clippel and Minelli (2004), without assuming transferable utilities. They show (their Proposition 1) that an allocation is an equilibrium allocation of the mechanism-proposal game if and only if, whatever the state, the interim expected payoffs of the principal and the agent are higher than their interim expected payoffs at the “best safe”
allocation (i.e., the best allocation for the seller that satisfies ex-post participation constraints). With transferable utilities, the “best safe” allocation extracts all surplus in each state and cannot be dominated for the principal by any other feasible allocation (it is a strong solution in the sense of Myerson, 1983), so it is the unique equilibrium allocation. On the contrary, when utility is not transferable, the best safe allocation may be dominated (see Example 2 in De Clippel and Minelli, 2004). It would be interesting to study intermediate models in which information can only be certified by the principal but utilities are not transferable. This is left for future research.

References


MILGROM, P. (2008): “What the seller won’t tell you: persuasion and disclosure in markets,”

Econometric Society, 1767–1797.


