INEFFICIENT PRE-BARGAINING SEARCH

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Abstract

We identify conditions under which a bargainer makes inefficiently large (small) investments in search for information about the opponent's reservation price. The analysis starts with the observation that a player will invest too much (too little) if the opponent's expected payoff is decreasing (increasing) in the probability that the player gets information. We develop comparative static results about over- and under-investment as a function of the efficiency and distributional properties of mechanisms, their dependence on search outcomes, and the nature of the trading problem. The results do not depend on any specific bargaining mechanism and are illustrated in several examples.

1. INTRODUCTION

The paper contributes a building block towards a formal theory of institutions by looking at a class of "haggling" (Coase, 1937) or "rent-seeking" (Tullock, 1980) costs. Specifically, we identify conditions under which a bargainer engages in too little or too much search for information about the opponent's reservation value. Our conditions apply to any bargaining games, but are still surprisingly simple. The key trade off is that information acquisition has a surplus-increasing component as well as a rent-seeking component, and whether there is under- or over-investment depends on the relative size of these two components. Our main result is that a player will be willing to invest too much (little) to acquire information which, if he had it, would reduce (increase) the expected value of the opponent's payoffs. There is more scope for this if the pre (post) search mechanism is more (less) efficient, if the pre (post) search mechanism gives the opponent a higher (lower) share, and if the first best probability of trade in the pre-search trading problem are larger. For example, a player will invest too much trying to get a signal which would allow him to appropriate all surplus.

The search behavior modeled here would often be seen as "market research" and is subject to both regulation and subsidy. On one hand, there are limits to the information that may be collected and asked for, and on the other hand governments help market researchers by making certain types of information available. The central message of the paper is that one ought to pay attention to the bargaining power conferred by the information. To the extent that the information enhances the efficiency of trade, one would want the seller to gain some – not too much and not too little - bargaining power by becoming informed.

Broad evidence suggests that bargainers with better information about their opponents tend to achieve superior results (Busse, Silva-Risso, and Zettelmeyer, 2006; Richtel, 2008). Perhaps because of this, purchasing agents spend more time preparing to negotiate than actually doing so (Bradley), and some firms prohibit non-procurement employees from having contact with suppliers (Simester and Knez, 2002). Such attempts to gather information, or raise the opponent's costs of doing so, are suggestive of the forces driving our result.

The paper has no close cousins, but contributes to knowledge in two areas. It is the first paper to go beyond a reduced form representation of bargaining costs incurred *before* the bargaining process and the first paper to look at the possibility of under-investment as well as over-investment. The literature has offered reduced form models in which there always is over-investment (e. g. Tullock, 1980; Ashenfelter and Bloom, 1993).

In the area of pre-play information acquisition, it is the first paper to offer results that do not depend on a specific mechanism and the first paper to look specifically at bargaining. There are many deep works in this area, focused on different auctions (Cremer, Spiegel, and Zheng, 2006; 2009), ultimatum games (Gehrig, Guth, and Levinsky, 2006), and the Vickrey-Clarke-Groves scheme (Bergemann and Valimaki, 2002; Bergemann, Shi, and Valimaki, 2009). These papers give regions in which there will be over- or under-investment in information, contingent on a specific mechanism being played. [1] Our contribution is complementary and akin to comparative statics between mechanisms. We predict whether equilibrium will exhibit over- or under-

[1] Conditions for over- vs. under-nvestment have also been investigated in other contexts such as labor training (Acemoglu and Pischke, 1998, 1999.)

investment as a function of efficiency and distributional properties of mechanisms, the way in which these depend on search outcomes, and the nature of the trading problem.[2] We apply the results to several examples, each showing that two seemingly similar trading problems can lead to very different search behaviors.

After introducing the model and presenting the main arguments in Section 2, we look at the examples in Section 3. The paper ends with a brief discussion.

2. MODEL AND MAIN RESULTS

We are looking at a trading problem with a single object, one seller and one buyer. Seller and buyer have private knowledge about their valuations, c and v, respectively. Uncertainty is represented by a set of possible states of the world Ω_c x Ω_v, where Ω_c and Ω_v are compact subsets of the positive reals. Anticipating future needs, we will denote the lower bound of Ω_v by $\underline{v}$. Both players know that the seller's cost c is drawn from the atomless (prior) distribution G_p: $\Omega_c \rightarrow [0, 1]$ and that the buyer's valuation v is drawn independently from the also atomless F_p: $\Omega_v \rightarrow [0, 1]$.

If the players bargain without gathering further information, they play the pre-search mechanism which we will index by p (for prior). Appealing to the revelation principle, we will represent p by the corresponding incentive compatible direct mechanism. Under this mechanism the object is transferred with probability $q_p(c, v)$, while the buyer pays the seller an expected amount $a_p(c, v)$. So for a given (c, v), the seller's expected payoffs are

$$\Pi_p(c, v) = a_p(c, v) - q_p(c, v)c, \tag{1}$$

[2] Persico (2000) derives several general conditions about incentives to acquire information in decision problems, but is focused on auctions, rather than bargaining.

while the buyer's expected payoffs are

$$U_p(c, v) = - a_p(c, v) + q_p(c, v)v. \tag{2}$$

We assume that the game is ex interim individually rational such that $E_v\Pi_p(c) \geq 0$ for all $c \in \Omega_c$ and $E_cU_p(v) \geq 0$ for all $v \in \Omega_v$.

Instead of playing p, the seller can acquire information beyond his priors by receiving a noisy signal about the buyer's valuation. The seller may observe a signal with probability $e \in [0, 1]$ by incurring search cost $k(e)$. We assume that the signal is drawn from the finite set Y, that $k(0)=0$, that $k(\ )$ is continuous and convex, and that $k(e) \rightarrow \infty$ as $e \rightarrow 1$. After observing the realized signal y, the seller uses Bayes' rule to revise his prior probability density $f_p(v)$ to a posterior $f(v\,|\,y)$. If the probability of observing y given $t \in \Omega_v$ is $\mu(y\,|\,t)$, then

$$f(v\,|\,y) = \mu(y\,|\,v)f_p(v)/[\int\mu(y\,|\,t)dF_p(t)]. \tag{3}$$

We assume that all these posteriors are atomless and for convenience also that they have the same support as $f_p(v)$.

To maximize the transparency of the argument, we make two simplifying assumptions about the nature of search. First, to ensure that posteriors are common knowledge, we assume that the buyer observes the signals. Second, to avoid complications from search decisions being used to signal valuations, we assume that the seller decides on search before observing his own valuation.[3] These assumptions are discussed in Section 4.

If the seller observes y, the players bargain based on $f_y(\ |\,y)$ and $g_p(\ )$, using the post-search mechanism indexed by (y). If the seller searches but fails to observe a signal,

[3] Most papers in the literature use formulations in which these complications are avoided. (i. e. Bergemann and Valimaki, 2002).

they play the pre-search mechanism. We make no assumptions about the relationship between the pre and post-search mechanisms, nor about the relationship between the mechanisms played after different search outcomes. We represent all these mechanisms by the corresponding incentive compatible direct mechanisms. So for the mechanism *(y),* the object is transferred with probability $q_y(c, v \mid y)$, the buyer pays the seller an expected amount $a_y(c, v \mid y)$, and the expected payoffs are

$$\Pi(c, v \mid y) = a_y(c, v \mid y) - q_y(c, v \mid y)c - k(e), \tag{4}$$

and

$$U(c, v \mid y) = - a_y(c, v \mid y) + q_y(c, v \mid y)v. \tag{5}$$

Recapitulating, the sequence of events in each of our trading problems is as follows:

1. The seller makes a search decision e.
2. The seller and buyer learn c and v, respectively. They both learn the value *(y)* of any signal received.
3. The payoffs are distributed.

In equilibrium, the seller will select $e^o = Argmax\ E\Pi(e)$, while the efficient search investments are $e^* = Argmax\{EU(e) + E\Pi(e)\}$. This motivates the following simple, but very useful, observation:

***Lemma 1**: $e^o > e^*$ if and only if $E_{cvy}U(c, v \mid y) < E_{cv}U(c, v)$.*[4]

[4] I am indebted to a referee for pointing out that there is a close correspondence between the Lemma and Acemoglu and Pischke's (1999, 1998) result, that the amount of employer-provided training depends on the extent to which the marginal benefit for the firm reflects the social benefit of training.

Proof: Social return to investment is maximized at $k'(e^*) = \partial[EU(e) + E\Pi(e)]/\partial e$, while the seller's private return is maximized at $k'(e^o) = \partial E\Pi(e)/\partial e$. So the two are identical if $\partial EU(e)/\partial e = 0$. Since $k(e)$ is convex, $\partial EU(e)/\partial e < 0$ implies $e^* < e^o$, while $\partial EU(e)/\partial e > 0$ implies $e^* > e^o$.

Q. E. D.

In words, the seller will invest too much (little) if the buyer's ex ante expected payoff when the seller gets information is smaller (larger) than his ex ante expected payoff if the seller does not get information.

We now rewrite payoffs in a couple of ways to focus on how different components change as the seller gets better information. This allows us to associate these changes with properties of the pre- and post-search mechanisms, as well as the trading problem itself. The two angles give somewhat similar insights, but there are differences, and in any given application, one format may be easier to evaluate than the other.

By using the envelope theorem on the IC constraint, we can rewrite the expected payoff of a buyer with valuation v' when the seller observes a specific y' as[5]

$$E_cU(c, v' \mid y') = E_cU(c, \underline{v'} \mid y') + \int^{v'} E_c q_{y'}(c, t_v \mid y') dt_v. \tag{6}$$

Taking the expectation over v' and y' allows us to restate Lemma 1 as

Lemma 1A: *$e^o > e^*$ if and only if*

$$\sum_Y \int\int^t\int q_y(t_c, t_v \mid t_y) dG_p(t_c) dt_v \mu(t_y \mid t) dF_p(t) - \int\int^t\int q_p(t_c, t_v) dG_p(t_c) dt_v dF_p(t).$$
$$< \int U(t_c, \underline{v}) dG_p(t_c) - \sum_Y \int U(t_c, \underline{v} \mid t_y) dG_p(t_c) \mu(t_y \mid \underline{v}) \tag{7}$$

[5] See also Theorem 1 in Myerson and Satterthwaite (1983)

While we have not specified how the mechanisms vary with information, we will look at several different scenarios. First, we might assume that information causes the expected probability of trade to be weakly larger.

$$E_{cy}q_y(c, v \mid y) \geq E_c q_p(c, v) \text{ for all } v \in \Omega_v. \qquad (A1)$$

This is not unreasonable if the mechanisms are more or less the same regardless of information (although we look at a counter-example in Section 3). One might also assume that information causes the expected payoffs to the lowest type buyer to be weakly larger.

$$E_c U(c, \underline{v}) \leq E_{cy} U(c, \underline{v} \mid y). \qquad (A2)$$

This is stronger, but we would expect the low types to benefit most from the seller getting better information. A sufficient condition for *(A2)* is that $E_c U(c, \underline{v}) = 0$. Since the IR constraints are slack if $E_c U(c, \underline{v}) > 0$, *(A2)* is a very reasonable assumption in at least some economic settings. In any case, we have

Finding 1: Given *(A1)* and *(A2)*, the seller will under-invest.

Second, if the pre-search mechanism implements all trades with probability one, the left hand side of *(7)* is at most zero and we will get over-investment if the left side is positive. So if

$$E_c q_p(c, v) = 1 \text{ for all } c, v \in \Omega_c \times \Omega_v \qquad (A3)$$

and

$$E_c U(c, \underline{v}) > E_{cy} U(c, \underline{v} \mid y). \qquad (A4)$$

we have

Finding 2: Given *(A3)* and *(A4)*, the seller will over-invest.

We can also use continuity to immediately get several comparative static type results.

Finding 3: Suppose there are two trading problems *T1* and *T2* which are identical in all but one of the four terms in *(7)*. Under either of the following circumstances,

(3.1) expected payoffs to the lowest type in the pre-search mechanism are higher in *T2*,

(3.2) expected payoffs to the lowest type in the post-search mechanism are lower in *T2*,

(3.3) the probability distribution of trade in the pre-search mechanism in *T2* first order stochastically dominates that in *T1*, and

(3.4) the probability distribution of trade in the post-search mechanism in *T2* is first order stochastically dominated by that in *T1*,

then, if there is over-investment in *T1*, there must be over-investment in *T2* and there may be over-investment in *T2*, but not in *T1*.[6]

Another way to develop intuition about Lemma 1 is to look directly at the effects of information on total surplus and the informational rents accruing to the buyer. To this end, we denote total expected surplus by $\beta(y)$ and the buyer's expected share of it by $\alpha(y)$, with $\beta(0)$ and $\alpha(0)$ referring to the pre-search mechanism. With this notation, we can write the buyer's expected payoff as $e\sum_Y \beta(y)\alpha(y)\int\mu(y \mid t)dF_p(t) + (1-e)\beta(0)\alpha(0)$, the

[6] In the interest of brevity, we omit the symmetric Finding about under-investment.

marginal effect of seller search is proportional to $\sum_Y \beta(y)\alpha(y)\int\mu(y \mid t)dF_p(t) - \beta(0)\alpha(0)$, and we have

Lemma 1B: *$e^o > e^*$ if and only if*

$$E_y\,[\beta(y) - \beta(0)]\,\alpha(y) < E_y\,\beta(0)[\alpha(0) - \alpha(y)] \tag{8}$$

This formulation throws a slightly different light on the relationship between over- and under-investment and the way in which the mechanisms vary with information. The seller's incentives to over-invest are larger when the expected efficiency gain $\beta(y) - \beta(0)$ is smaller or the expected decrease in the buyer's informational rents $\alpha(0) - \alpha(y)$ is larger.

Recall that efficiency and shares are subject to ceiling effects. So if the pre-search mechanism implements all efficient trades,

$$E_c q_p(c, v) = 1 \text{ for all } c < v \in \Omega_c \times \Omega_v \tag{A5}$$

and the buyer's expected post-search share is smaller than the pre-search share

$$\alpha(0) > E_y\,\alpha(y), \tag{A6}$$

we have

Finding 4: Given *(A5)* and *(A6)*, the seller will over-invest.

Similarly, if the post-search mechanism gives all surplus to the seller,

$$\alpha(y) = 0 \text{ for all } y \in \Omega_v, \tag{A7}$$

we have

Finding 5: Given *(A7)*, the seller will over-invest.

This would, for example, apply to trading problems in which search gives the seller perfect information and the right to make a take-it-or-leave-it offer.

Much like we did with *(7)*, we can use *(8)* and continuity to get several simple comparative static type results.

Finding 6: Suppose there are two trading problems *T1* and *T2* which are identical in all but one of the four terms in *(8)*. Under either of the following circumstances,

(6.1) expected surplus in the pre-search mechanism are higher in *T2*,

(6.2) expected surplus in the post-search mechanism are lower in *T2*,

(6.3) the buyer's expected share of surplus is higher in the pre-search mechanism in *T2*, and

(6.4) the buyer's expected share of surplus is lower in the post-search mechanism in *T2*,

then, if there is over-investment in *T1*, there must be over-investment in *T2* and there may be over-investment in *T2*, but not in *T1*.[7]

Consider finally a comparison between two mechanisms. Suppose that the two trading problems *T1* and *T2* face the same priors and the same search technology (and thus the same posteriors), and only differ because *T1* uses the bargaining mechanism *M1* at all information sets, while *T2* uses *M2* at all information sets. Now assume

$$\alpha_1(y) = \alpha_2(y) \text{ for all } y,\ \alpha_1(0) = \alpha_2(0), \text{ and } \alpha(0) > E\alpha(y), \qquad (A8)$$

[7] In the interest of brevity, we again omit the symmetric Finding about under-investment.

(*M1* and *M2* split the surplus identically at all information sets and the buyer can expect a smaller share after search),

and

$$\beta_1(0) > \beta_2(0)) \text{ and } \beta_1(y) - \beta_1(0) < \beta_2(y) - \beta_2(0) \text{ for all } y \neq 0. \qquad (A9)$$

(*M1* is more efficient at the prior and gains less efficiency between the prior and any posterior, possibly because of ceiling effects. This gives

Finding 7: <u>Suppose the two trading problems *T1* and *T2* face the same priors and the same search technology, that *T1* uses the bargaining mechanism *M1* at all information sets, that *T2* uses *M2* at all information sets, and that *A(8)* and *A(9)* hold. Then there is less investment in *T1*,which uses the ex ante more efficient mechanism.</u>

Proof: In terms of the marginal effects of search, (A8) and (A9) imply that

$$\begin{aligned}
&\textstyle\sum_Y \beta_1(y)\alpha_1(y)\int\mu(y|t)dF_p(t) - \beta_1(0)\alpha_1(0) \\
&= \textstyle\sum_Y [\beta_1(y) - \beta_1(0)]\ \alpha(y)\int\mu(y|t)dF_p(t) - \beta_1(0)[\alpha(0) - E\alpha(y)] \\
&< \textstyle\sum_Y [\beta_2(y) - \beta_2(0)]\ \alpha(y)\int\mu(y|t)dF_p(t) - \beta_2(0)[\alpha(0) - E\alpha(y)] \\
&= \textstyle\sum_Y \beta_2(y)\alpha_2(y)\int\mu(y|t)dF_p(t) - \beta_2(0)\alpha_2(0) \qquad (9)
\end{aligned}$$

So the incentives to search are larger in *M2*.

Q. E. D.

In other words, under the stated conditions, the more efficient mechanism is associated with less over-investment or more under-investment.

3. EXAMPLES

3.1 More Scope for Over-investment when Pre-search Trade is Closer to Efficient.

We first illustrate the logic from Findings 3.3 and 6.1, that ceiling effects generate more scope for over-investment when the pre-search mechanism is closer to being fully efficient. To this end, we use the sealed bid double auction analyzed by Chatterjee and Samuelson (1983) to illustrate that the seller will over-invest if the first best probability of trade is sufficiently high. To this end we compare a "high probability" case in which the priors $G_p(\,), F_p(\,)$ are uniform distributions over $[0, 1]$ and $[1/2, 3/2]$, respectively, against a "low probability" case in which they are uniform on $[1/2, 2/3]$ and $[0, 1]$. In either case we assume that signals may be either "high" or "low", $Y = \{h, l\}$, perfectly revealing whether the buyer's valuation is in the upper or lower half of the support.

Since the seller can refrain from searching, search and receive good news, or search and receive bad news, bargaining takes place under one of three possible information structures. We assume that the same sealed bid bargaining game is played in all cases. Specifically, seller and buyer submit sealed offers, S and B, respectively. The object and a payment are transferred if and only if $B \geq S$, and the payment equals the average of the two bids $(B + S)/2$.

Using the notation that $F()$ is uniform between $\underline{v}$ and v_b, while $G(\,)$ is uniform between $\underline{c}$ and c_h, we can generalize Chatterjee and Samuelson (1983) to show that the seller's equilibrium bidding strategy is

$$S(c) = 2\underline{v}/3 + v_h/12 + \underline{c}/4 \quad \text{for } c < \underline{v} - v_h/4 + \underline{c}/4$$

$$= 2c/3 + v_h/4 + \underline{c}/12 \quad \text{for } \underline{v} - v_h/4 + \underline{c}/4 \leq c \leq 3v_h/4 + \underline{c}/4$$

$$\geq 2c/3 + v_h/4 + \underline{c}/12 \qquad \text{for } 3v_h/4 + \underline{c}/4 < c, \tag{9}$$

while the buyer's equilibrium bidding strategy is

$$B(v) \leq 2v/3 + v_h/12 + \underline{c}/4 \qquad \text{for } v < v_h/4 + 3\underline{c}/4$$

$$= 2v/3 + v_h/12 + \underline{c}/4 \qquad \text{for } v_h/4 + 3\underline{c}/4 \leq v \leq c_h + v_h/4 - \underline{c}/4$$

$$= 2c_h/3 + v_h/4 + \underline{c}/12 \qquad \text{for } c_h + v_h - \underline{c}/4 < v. \tag{10}$$

The sealed bid double auction is thus not incentive compatible in the sense that the bids do not correspond to the underlying values. However, we will use Lemma1 on the incentive compatible direct mechanism implementing the same outcomes. We consider three cases, that the seller gets no news, bad news, or good news.

In the "high probability" game, if the seller gets no news, *(9)* and *(10)* gives

$$S(c) = 11/24 \qquad \text{for } c < 1/8$$

$$= 2c/3 + 3/8 \qquad \text{for } c \geq 1/8$$

and

$$B(v) = 2v/3 + 1/8 \qquad \text{for } v < 11/8$$

$$= 25/24 \qquad \text{for } v \geq 11/8$$

From these, expected payoffs to the lowest type buyer are $1/192$ and the probability of trade as a function of v is $v - 3/8$ for $v < 11/8$ and 1 for $v \geq 11/8$. After simple calculation, we find that the expected payoff to the buyer is $719/3072 \approx .234$. If the seller gets good news, the expected payoffs to the lowest type buyer are $(5/8)(5/24) = 25/192$ and the buyer's expected payoffs are $\approx .327$. If the seller gets bad news, the expected payoffs to the lowest type buyer are $1/48$, while the buyer's expected payoffs are $\approx .125$. As good and bad news are equally likely, the buyer's expected payoff, if the seller searches, is $(.327 + .125)/2 \approx .226$. So Lemma1 tells us that the seller will over-invest.

In the "low probability" game, if the seller gets no news, the buyer's expected payoff is $9/1024 \approx .0088$. Further, the buyer's expected payoff is 0 if the seller gets bad news and $18/1024$ if he gets good news. So in this case the buyer's expected payoff is the same ($9/1024$) whether or not the seller gets information, implying that the latter neither over-invests, nor under-invests.

3.2 More Scope for Over-investment with more Efficient Mechanisms

We now illustrate Finding 7, if the pre and post-search mechanisms are the same, there is more scope for over-investment the more efficient this mechanism is. To this end, we contrast the "more efficient" mechanism identified by Myerson and Satterthwaite (1983) with a "less efficient" mechanism that lets each player make a TIOLI offer with probability .5. The priors, $F_p(\ )$ and $G_p(\ )$, are both uniform distributions over $[0, 1]$, $Y = \{h, l\}$ and $\mu(h \mid v) = v$. So the posteriors are $f_h(v \mid h) = 2v$ and $f_l(v \mid l) = 2(1 - v)$. In both cases, we assume that all three bargaining games, that under the prior information structure, that under $f_h(v \mid h), g_p(c\ )$, and that under $f_l(v \mid l), g_p(c\ )$, are governed by the same mechanism.

The "more efficient" mechanism is such that

$$q^{\alpha}(c, v) = 1 \quad \text{if } c + \alpha\, G(c)/g(c) \leq v - \alpha[1 - F(v)]/f(v),$$

$$q^{\alpha}(c, v) = 0 \quad \text{if } c + \alpha\, G(c)/g(c) > v - \alpha[1 - F(v)]/f(v),$$

and

$$\iint \{t_v - [1 - F(t_v)]/f(t_v) - t_c - G(t_c)/g(t_c)\} q^{\alpha}(t_c, t_v) g(t_c) f(t_v) dt_c dt_v = 0$$

If the seller gets no news, $\alpha = 1/3$ and the probability of trade is 0 for $v < 1/4$ and $v - 1/4$ for $v \geq 1/4$. If the seller gets good news, $\alpha \approx .35$ and the probability of trade is 0 for $v < .385$

and $.871v - .129/v$ for $v \geq .385$. Conversely, if the seller gets bad news, $\alpha \approx .22$ and the probability of trade is 0 for $v < .097$ and $.911v - .089$ for $v \geq .097$. The buyer's expected payoffs when the seller does and does not search is $\approx .067$ and $\approx .070$, respectively, implying over-investment.

In the "less efficient" mechanism each player makes a TIOLI offer with probability *.5*. If the buyer makes the offer, her expected payoffs will be *1/12* whether or not the seller has received any information. If the seller makes the offer, the buyer can expect *1/24*, *.587..*, or *2/81* depending on whether the seller has received no information, good news, or bad news. So the buyer's expected payoffs when the seller does and does not search is $\approx .0633$ and *.0625*, respectively, implying under-investment.

3.3 More Scope for Under-investment if the Post-Search Mechanism is More Efficient

We now illustrate the logic from Findings 3.4 and 6.2, that there is more scope for under-investment if the post-search mechanism is more efficient. To liven things up, we look at an example with different pre and post-search mechanisms. The priors, $F_p(\,)$ and $G_p(\,)$, are uniform distributions over $[0, 2]$ and $[0, 1]$, respectively, $Y = \{h, l\}$ and the seller's posterior is uniform on $[0,1]$ or $(1, 2]$ depending on the signal received. We assume that the parties play the most efficient mechanism under the prior or if the seller gets bad news, but we contrast two mechanisms for the case in which the seller gets good news. The "more efficient" mechanism prescribes trade at the price *1*, and the "less inefficient" mechanism has each player making a TIOLI offer with probability .5.

We proceed as in the previous example to find that the buyer's expected payoffs without search are *.271*, while they are *.070* after bad news. After good news, the "more efficient" mechanism gives the buyer expected payoffs of *.5*, while the "less efficient" mechanism only gives *7/16*. So the buyer's expected payoffs after search are *.285* and *.254*, respectively, and the "more efficient" post-search mechanism gives under-investment, while the "less efficient" mechanism gives over-investment.

3.4 Fully Informative Signals and TIOLI Offers Lead to Over-investment

We finally illustrate the force in Finding 6.4 that mechanisms allowing a better informed player to appropriate most or all of the opponent's payoffs give more scope for over-investment. Suppose that each player gets to make a TIOLI offer with probability *.5* and that $y = v$ such that the seller potentially gets complete information. If the buyer makes the offer, her expected payoffs are the same with and without search. However, if the seller makes the offer after search, the buyer gets zero payoffs. So the seller will over-invest.

4. DISCUSSION

The paper contributes to two literatures; it partially unpacks a class of bargaining costs and it addresses the question of pre-play information acquisition from a new angle. We will discuss each in turn.

Costless ("Coasian") bargaining is a widely used and extremely convenient assumption in economic models. However, if bargaining costs are of non-trivial magnitude, this assumption blinds us to agents' attempts at designing institutions that economize on them. Informal theories of economic institutions long have argued for the central importance of concepts such as "haggling costs" and "rent seeking" (Coase, 1937;

Williamson, 1975; Tullock, 1980), both of which have received little explicit treatment in the more formal literature. Consistent with this, some observers feel that ideas are more likely to be used by others once they are "embalmed" in a workhorse formal model (Krugman, 1995, p. 27). A possible contribution of the present paper is to provide a model of bargaining costs that is simple enough to be incorporated in larger models (Wernerfelt, 2010) and yet is consistent with standard assumptions.

The existing literature on pre-play information acquisition uses a "bottom up" approach; assuming that a particular mechanism is used throughout, it looks for properties of the trading problem and the search process under which there will be too little, too much, or just the right amount of search. We have here taken the opposite, "top down", approach, by looking for efficiency as a function of properties of mechanisms, the way in which they depend on search outcomes, and the nature of the trading problem. Our comparative static results are not as deep as those developed by the bottom up literature, but they do throw new and complementary light on the problem. Furthermore, our examples show that the results are sufficiently strong to identify important differences between seemingly quite similar mechanisms and trading problems.

The extensive form analyzed is subject to two critiques: The search decision does not depend on valuations and the outcomes of search are assumed to be publicly observable. While these points are well taken, they are not universally valid. In some cases the objects of bargain are revealed very shortly before agreements have to be finalized, forcing the parties to investigate each others' "type" well in advance of knowing valuations (e. g. many labor services). In other cases opponents have to be asked or informed about information (e. g. if they are obligated to give out information on request or if a third party, such as a credit bureau has to inform them of any search activity). Finally, there are cases in which only one signal is relevant and yet is of uncertain availability (e. g. an old expert opinion on an antique). We nevertheless admit that the critiques have significant force and we will now discuss how one can generalize the analysis in each of the two directions thus indicated

Suppose first that we change the extensive form such that the seller's search decision is made after he learns his valuation. The complication here is that the buyer can use the seller's search outcome as a noisy signal of his costs. We can write the mechanisms as $a(c, v|\, y, \boldsymbol{e^o})$ and $q(c, v|\, y, \boldsymbol{e^o})$,, where $\boldsymbol{e^o}$ denotes the search strategy $e^o(t_c)$ for all $t_c \in \Omega_c$. The complicated way these mechanisms may depend on the players' information means that we cannot invoke the Fan-Glicksberg existence theorem, nor the second order conditions, without making very strong restrictions on the class of mechanisms used.

Instead, we can gain intuition by pursuing another approach. In most natural bargaining games, *a( )* and *q( )* are such that stronger players will find information more valuable; the subjective probability of trade is higher as are the marginal returns from making it happen. This suggests that both the efficient search strategy $\boldsymbol{e^*}$ and the equilibrium search strategy $\boldsymbol{e^o}$ are decreasing. However, since seller will want the buyer to think that he is weak, the buyer's ability to draw inferences about the seller's search intensity will lower his equilibrium incentives to search. So compared to the model analyzed in Section 2, we should here expect a greater tendency to under-invest.

Consider now an extensive form in which the seller's search outcomes remain his private information. Since the buyer's strategy in general will depend on the seller's beliefs, this causes issues with the Common Knowledge of Common Prior assumption. It is not clear that the current literature offers a good general solution to this problem. However, in the present context, we can still salvage some results by restricting attention to mechanisms in which **e**ach player's bargaining strategy is independent of the opponent's information. While this is a strong requirement, it is met by many commonly studied mechanisms with a flavor of second price auctions and take-it-or-leave-it offers.

Beyond the two issues discussed above, a possible avenue for future research is to characterize different classes of mechanisms in a way that can sharpen the comparative static results. This might ultimately allow us to merge the bottom up and top down perspectives.

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